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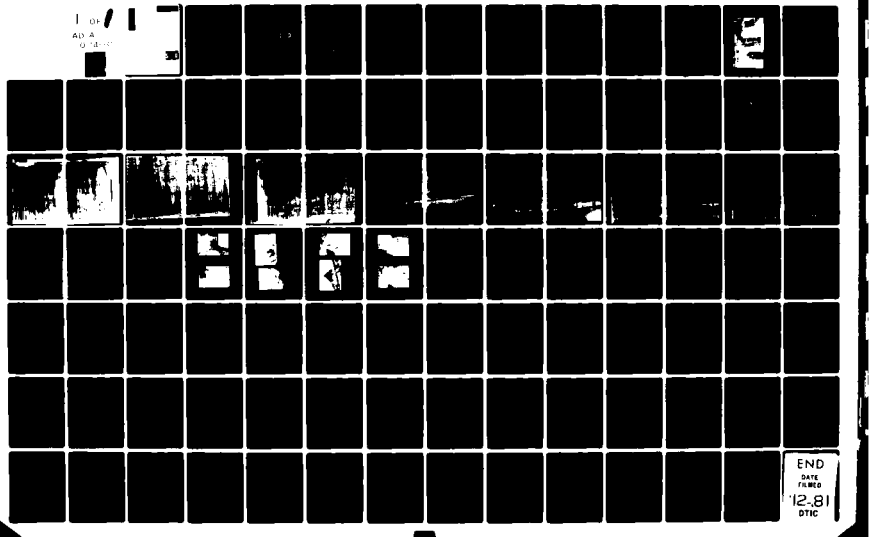

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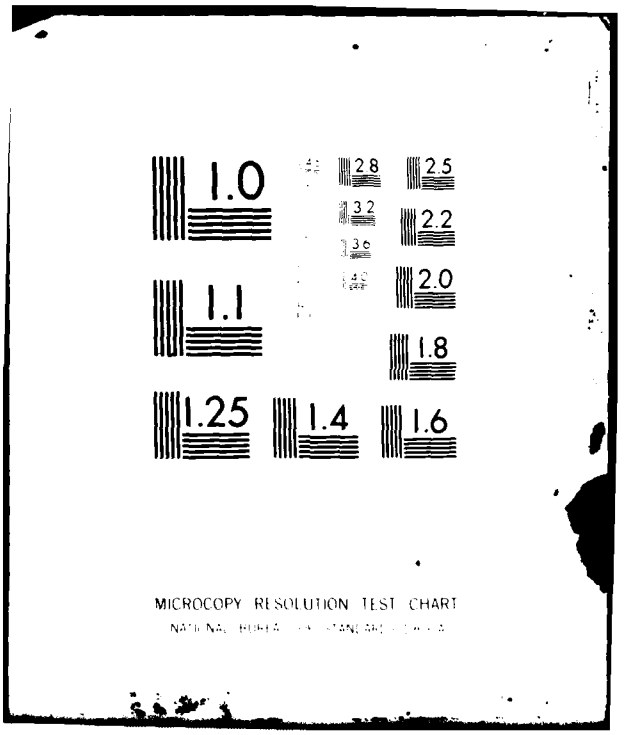
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11. CONTROLLING OFFICE NAME AND ADDRESS Department of the Army 26 Federal Plaza New York District, CofE New York, New York 10287 (11)	12. REPORT DATE 09 September 1981
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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dam Safety
National Dam Safety Program
Visual Inspection
Hydrology, Structural Stability
Greenhaven Correction Facility Dam
Dutchess County
Lower Hudson River Basin

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report provides information and analysis on the physical condition of the dam as of the report date. Information and analysis are based on visual inspection of the dam by the performing organization.

Examination of the available documents and visual inspection of the Greenhaven Correction Facility Dam did not reveal conditions which constitute a hazard to human life or property.

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Using the Corps of Engineers screening criteria for review of spillway adequacy, it has been determined that the concrete gravity dam would be overtopped for all storms exceeding approximately 38.8 percent of the Probable Maximum Flood (PMF). Although the spillway capacity is inadequate from a hydraulic and hydrologic point of view, the hydraulic inadequacy will not affect the stability of the concrete dam section during overtopping nor the safety of the dam since it is supported on sound rock and overtopping will cause neither significant erosion at the toe or abutment nor undermine the foundation. In addition the dam stability is considered to be adequate against overturning and sliding.

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LOWER HUDSON RIVER BASIN

GREENHAVEN CORRECTION FACILITY DAM

DUTCHESS COUNTY, NEW YORK
INVENTORY NO. N.Y. 1170

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

NEW YORK DISTRICT CORPS OF ENGINEERS

SEPTEMBER 1981

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D. C., 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
GREENHAVEN CORRECTION FACILITY DAM
I.D. NO. N.Y. 1170
D.E.C. NO. 230C-4123
LOWER HUDSON RIVER BASIN
DUTCHESS COUNTY, N.Y.

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APPENDICES

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

NAME OF DAM:	Greenhaven Correction Facility Dam (I.D. No. N.Y. 01170)
STATE LOCATED:	New York
COUNTY LOCATED:	Dutchess
STREAM:	Gardner Hollow Brook
BASIN:	Hudson River
DATE OF INSPECTION:	July 8, 1981

ASSESSMENT

Examination of the available documents and visual inspection of the Greenhaven Correction Facility Dam did not reveal conditions which constitute a hazard to human life or property.

Using the Corps of Engineers screening criteria for review of spillway adequacy, it has been determined that the concrete gravity dam would be overtopped for all storms exceeding approximately 38.8 percent of the Probable Maximum Flood (PMF). Although the spillway capacity is inadequate from a hydraulic and hydrologic point of view, the hydraulic inadequacy will not affect the stability of the concrete dam section during overtopping nor the safety of the dam since it is supported on sound rock and overtopping will cause neither significant erosion at the toe or abutment nor undermine the foundation. In addition the dam stability is considered to be adequate against overturning and sliding.

However, the dam has a number of problem areas which require further attention. The following remedial and maintenance actions should be completed within one year.

- Removal of trash and debris from spillway channel
- Repair reservoir drain control works
- Remove vegetation from spillway crest and chute
- Repair cracked and deteriorating concrete on abutment spillway chute
- Backfill spillway chute wall and protect slope against erosion

- Provide a program of periodic inspection and maintenance of the dam and appurtenances including yearly operation and lubrication of the reservoir drain. Document this information for future references. Also develop an emergency action plan.

Eugene O'Brien, P.E.
New York No. 29823

Approved: for Col. W.M. Smith, Jr.
New York District Engineer

Date: 10 SEP 1981

1) OVERVIEW OF DAM

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
GREENHAVEN CORRECTION FACILITY DAM
I.D. NO. N.Y. 1170
D.E.C. NO. 230C-4123
LOWER HUDSON RIVER BASIN
DUTCHESS COUNTY, N.Y.

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority

The Phase I inspection reported herein was authorized by the Department of the Army, New York District, Corps of Engineers Contract No. 51-81-C-0008 Modification P00001 in fulfillment of the requirements of the National Dam Inspection Act, Public Law 92-367 dated 8 August 1972.

b. Purpose of Inspection

This inspection was conducted to evaluate the existing condition of the dam, to identify deficiencies and hazardous conditions, to determine if these deficiencies constitute hazards to life and property, and to recommend remedial measures where required.

1.2 DESCRIPTION OF PROJECT

a. Description of the Dam and Appurtenant Structures

Greenhaven Correction Facility Dam is a 176-foot long concrete gravity structure having a maximum crest height 38 feet at center and a 6-foot crest width. The dam (according to design drawings) is keyed into the foundation at the heel by a shear cut off wall extending between 5 and 15 feet into underlying bedrock. The upstream face of the structure is vertical whereas the downstream face slopes at 1.75V:1H entering into a curvilinear section forming the spillway apron near the base of the dam. Small piers are located at the crest to support a walkway spanning the spillway section (See photographs 2 and 3).

The service spillway (See photographs 1 and 3) is a central overflow section of the dam, 100 feet in width. The crest of the spillway is bi-level with a 50-foot long low level section having an invert of El.520 and the remaining 50-foot section having an invert of El.520.5. Discharge over the low level portion of the spillway flows down the face of the dam exiting on a curvilinear apron at the toe whereas overflow at the higher level portion of the spillway is directed to a chute descending from the right abutment to the brook located along the downstream face of the dam.

The dam is equipped with a 36-inch cast iron "Blowoff Line" reservoir drainage system passing through the dam near the left abutment. Flow through the drain is controlled by a gate valve operated from a gatehouse located near the left abutment on the crest of the dam.

b. Location

The dam is located approximately one-half mile north east of Poughquag, Dutchess County, New York.

c. Size Classification

The dam is 38 feet high and has a reservoir at this height with a storage capacity of 322 acre-feet and, therefore, is classified as a small dam.

d. Hazard Classification

The dam is in the "high" hazard potential category due to the location of occupied residences located downstream and within the flood plain.

e. Ownership

The dam is owned and operated by the New York State Department of Corrections, Greenhaven Correction Facility, Stormville, N.Y. 12582, telephone no. (914) 221-2711. Prime contact at the facility is Mr. Angelo Lonardo, Plant Superintendent.

f. Purpose

The dam was constructed to form a water supply reservoir for the Greenhaven Correction Facility.

g. Design and Construction History

The dam was designed and constructed by the State of New York, Department of Public Works circa 1939. Construction of the dam appears to be in general accordance with the original design.

h. Normal Operation Procedure

Discharge is uncontrolled through the service spillway. There appears to be no normal operating procedure established for the reservoir drain.

1.3 PERTINENT DATA

a.	Drainage Area, Square miles	4.45
b.	Discharge at Dam Site, cfs	
	Uncontrolled Service Spillway at Maxi. Pool	3324 cfs

	Reservoir Drain at Maxi. Pool (El.525.25)	Unknown
	Total Discharge at Maxi. Pool (El.525.25)	3324 + cfs
c.	Elevation, USGS Datum MSL	
	Crest of Dam	525.25*
	Maximum Design Pool	Unknown
	Spillway Crest (low level/high level)	520.0/520.5*
	Invert Reservoir Drain-Upstream	492.0*
d.	Reservoir	
	Length of Maximum Pool, feet	1900
	Surface Area @ Max. Pool, Acres	23.5
e.	Storage	
	Normal Pool	240 acre feet
	Maximum Pool	322 acre feet
f.	Dam	
	Type	Concrete Gravity
	Height, feet	38*
	Length, feet	176*
	Upstream Slope	Vertical
	Downstream Slope	1.75V:1H
	Crest Elevation, feet	525.25*
	Crest Width, feet	6*
	Cut off Type	Partially Reinforced concrete wall
	Grout Curtain	None
g.	Spillway	
	Type	Bi-Level slot in central portion of dam
	Crest Elevation, feet (low level/high level)	520.0/520.5*
	Width, feet	100*
	Flow Regulation	Uncontrolled
h.	Reservoir Drain	
	Type	C.I. Pipe
	Dimensions	36" I.D.
	Flow Regulations	Sliding Gate Valve

*Based on original design drawings

SECTION 2 - ENGINEERING DATA

2.1 GEOLOGY

The Greenhaven Correction Facility Dam is located in the Hudson Highlands Section of the New England Maritime Physiographic Province. The bedrock in the area consists of methamorphic, igneous and sedimentary rocks which have undergone a complex sequence of position, folding, faulting and erosion. In the vicinity of the damsite, bedrock consists of thinly bedded shales and limestones.

2.2 SUBSURFACE INVESTIGATIONS

There is no record of subsurface investigations for the dam. Shallow surficial soils along the dam alignment are presumed to be alluvial deposits associated with the Gardner Hollow Brook, whereas underlying soils projected as being of glacial origin.

2.3 Dam and Appurtenant Structures

The original design drawings for the Greenhaven Correction Facility Dam were reviewed on site. File copies were not available. Photographic reproductions of pertinent plans and portions of plates from the original designs drawings are presented in Appendix A.

2.4 CONSTRUCTION RECORDS

No information regarding the construction of the dam and its appurtenant structures is available. The dam was reportedly built circa 1940. Resurfacing of the abutment spillway chute has been performed.

2.5 OPERATING RECORDS

No systematic monitoring of the dam's performance is in effect at this time.

2.6 EVALUATION OF DATA

The information obtained from the available documents and visual inspection are sufficient to support a Phase I evaluation of the dam.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General

The visual inspection of Greenhaven Correction Facility Dam was made on July 8, 1981. The skies were clear with temperature ranging from 85° to 95°F. The reservoir level was estimated to be at El. 520.1 based on a water depth of about 1-inch flowing over the low level section at the spillway crest.

b. Dam

The overall structural stability of the dam is good with only minor spalling of the walkway piers being observed. The vertical and horizontal alignments of the dam exhibit no signs of noticeable movements.

c. Spillway

The spillway appears in good structural condition, with the exception of the upper level chute, located at the right abutment. This chute exhibits surface cracking and severe deterioration of a gunite surface layer near the base. Vegetation has become well established on both the spillway crest and on the abutment spillway chute. Minor erosion along the downstream wingwall was also observed. Minor seepage at the abutment spillway chute/dam contact was observed.

d. Appurtenant Structures

The gatehouse is unsecured. Reportedly as a result of vandalism the door is missing,as are the control mechanisms to operate the reservoir drain (See photograph 8).

e. Downstream Channel

Both the spillway and reservoir drain discharge directly into Gardner Hollow Brook immediately downstream of the dam (See photograph 9). Moderate amounts of trash and debris are present in the Brook immediately downstream of the dam.

f. Abutment

The dam abutment areas are in good condition. There does not appear to be either instability or seepage problems in these areas.

g. Reservoir Area

No slides or general instability were observed along the reservoir shorelines in the general vicinity of the dam. No significant sedimentation was observed along the dam.

3.2 EVALUATION OF OBSERVATIONS

Although deficiencies were observed, there is no indication that the dam is in imminent danger. Some of the deficiencies noted previously are minor and should be corrected in conjunction with routine maintenance. Other conditions described, however, represent conditions which may present potential for further deterioration and consequently need for further investigation and correction.

The following is a summary of the problem areas encountered and recommended corrective measures requiring immediate attention:

1) Replace reservoir drain control gears.

2) Repair major cracks and damaged concrete on spillway chute located at the right abutment.

3) The gatehouse should be properly secured to deter or prevent further vandalism of control mechanism.

4) A program of periodic inspection and maintenance of the dam and appurtenances including yearly operation and maintenance of the reservoir drain and its control facilities should be developed and implemented. Inspection should be documented for future reference. Also, an emergency action plan should be developed.

SECTION 4 - OPERATION AND MAINTENANCE PROCEDURES

4.1 PROCEDURES

No written operation and maintenance procedures exist for the project. The normal operation is to allow flow over the service spillway.

4.2 MAINTENANCE OF DAM

It is reported that no routine maintenance of the dam is performed.

4.3 WARNING SYSTEM IN EFFECT

No warning system is in effect or in preparation.

4.4 EVALUATION

The overall operation and maintenance of the Greenhaven Correction Facility Dam is considered inadequate as a result of the following conditions:

1. Inoperable reservoir drain valve (missing controls).
2. Vegetation growth on the spillway crest and spillway chute.
3. Absence of a written operation and maintenance procedure.
4. Absence of any written maintenance history.

SECTION 5 - HYDROLOGY/HYDRAULICS

5.1 DRAINAGE AREA CHARACTERISTICS

The Greenhaven Correctional Facility Dam is located on the Gardner Hollow Brook, Beekman township, Dutchess County, New York (HUC No. 02020008). The drainage area contributing to the reservoir is 4.45 square miles. It is rectangular in shape with wooded slopes varying in steepness from a maximum of about 26% to a 4% average channel slope (700 ft. in 17,000 ft.). There is relatively little storage within the basin and the reservoir occupies 14.7 acres or 0.5 percent of this area. There is very little development within the drainage basin.

5.2 ANALYSIS CRITERIA

The adequacy of the spillway was analyzed under the Probable Maximum Flood (PMF) in accordance with the Recommended Guidelines for Safety Inspection of Dams (Ref. 3). An inflow hydrograph for the Probable Maximum Precipitation (PMP), was developed using the Snyder method and the U.S. Corps of Engineers HEC-1DB computer program. The all season 200 square mile 24 hour PMP of 21.5 inches was obtained from HMR #33. The precipitation distribution was computed by the standard EM-1110-2-1411 method. Rainfall losses of 1.0 inch initial loss, and 0.1 inch per hour constant less selected for the PMF event. The average Snyder coefficient's of C_T=2 and 640 C_p=400 were selected for the basin. T_{pr} were computed to be 2.94 hours.

5.3 SPILLWAY CAPACITY

The spillway is an overflow section of the concrete gravity dam acting as an ogee weir having a hydraulic width of 90 feet and a length of 6 feet. The capacity of the spillway with the water surface at EL.525.25 (top of dam) is 3324 cfs.

5.4 RESERVOIR CAPACITY

The reservoir capacities at the spillway crest (EL.520) and the top of the dam (EL.525.25) are 240 acre-feet and 322 acre-feet, respectively. The computed surcharge storage of 82 acre-feet is equivalent to 0.34 inches of runoff over the entire drainage area.

5.5 FLOODS OF RECORD

There are no records of floods or maximum lake elevations.

5.6 OVERTOPPING POTENTIAL

The potential of the dams being overtopped was investigated on the basis of the spillway discharge capacity and the available surcharge storage to meet the selected design flood inflows.

The HEC-1DB analysis was performed assuming that the water surface of the reservoir was at spillway crest elevation (520.MSL) at the start of the flood event.

The results of the multi-ratio analysis are as follows:

RATIO OF PMF	PEAK INFLOW (cfs)	PEAK OUTFLOW (cfs)	OVERTOPPING (feet)
1.00	8601	8570	2.62
0.75	6451	6414	1.68
0.50	4301	4271	0.60
0.25	2150	2131	0.0

The maximum spillway discharge capacity is 38.8 percent of the PMF peak outflow.

5.7 EVALUATION

The spillway is unable to pass either the PMF or one half PMF without the dam being overtopped. The inability of the spillway to pass a 1/2 PMF event will not affect the safety of the concrete dam. Since it is founded and keyed into sound bedrock at both the foundation and abutment areas. Overtopping will cause neither significant erosion at the toe or abutment, nor undermine the foundation of the dam. Therefore, the spillway is judged as being inadequate.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations

Visual observations did not reveal any conditions which at present adversely affect the structural stability of the dam.

b. Design and Construction Drawings

Original design drawings conform to the structure as it stands today. No construction drawings or record of construction are available.

c. Operating Records

There are no operating records for the dam.

d. Post-Construction Changes

There are no reported major post-construction changes to the dam. Some repair work to patch-up cracks and deteriorating concrete in the abutment spillway chute has been performed.

e. Seismic Stability

The dam is located in Seismic Zone 1 and in accordance with recommended Phase I guidelines. However, based on the past earthquake activity in the area, the New York State Geological Survey considers the area to be more characteristics of a Zone 2 setting. Based on this assessment the dam is considered in the Seismic Zone 2.

6.2 STRUCTURAL STABILITY ANALYSES

Structural stability analyses were performed to evaluate both sliding and overturning potential of the maximum overflow section with respect to five critical loading conditions.

Analyses were performed with results being assessed in accordance with procedures recommended by the U.S. Army Corps of Engineers (Ref. 1). Results of the analyses are summarized as follows:

Case	Loading Condition	Location of Resultant	Sliding F.S.
I.	Normal loading condition, reservoir level at spillway crest, no ice load	Within middle third	8.50
II.	Normal loading condition reservoir level at spillway crest, no ice load	1.46 feet outside middle third	4.81

III.	Unusual loading: flood level equal to 1/2 PMF at maximum section	3.83 feet outside middle third	3.18
IV.	Extreme loading: flood level equal to PMF at the maximum section	5.50 feet outside middle third	3.02
V.	Unusual loading: reservoir level at spillway crest, and earthquake forces	Within base	4.67

The results of the stability analysis based on resultant force locations indicate that stability of the dam against overturning is inadequate for all loading conditions except for Cases I & V.

Sliding stability of all cases, however, is acceptable in terms of the Corps of Engineers' Criteria.

Further analyses of Cases II,III and IV to determine maximum foundation pressures associated with the otherwise unacceptable eccentric loading show that maximum bearing pressures ranging between 31.39 and 33.52 psi would result. These values are well within the allowable bearing capacity available from the foundation rock. Minimum bearing values resulting from the eccentric loading of the foundation were calculated to range between -13.00 and -4.54 psi.

With consideration of the relatively low bearing pressures resulting from the otherwise unacceptable resultant force eccentricities as compared to that available from the competent foundation rock the stability of the dam for Cases II, III and IV with regards to overturning is considered acceptable.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety

Examination of available documents and the visual inspection of the Greenhaven Correction Facility Dam and appurtenant structures did not reveal any conditions which constitute a hazard to human life or property. The dam is not considered to be unsafe.

Using the Corps of Engineers' screening criteria for review of spillway adequacy, it has been determined that the concrete gravity dam would be overtopped for all storms exceeding approximately 38.8 percent of the PMF. Although the spillway capacity is inadequate from a hydraulic and hydrologic point of view, the hydraulic inadequacy will not affect the safety of the dam because the concrete dam is supported on sound rock and overtopping of the dam will cause neither significant erosion at the toe or abutment, nor undermine the foundation of the dam. In addition, the concrete dam is stable under all loading conditions.

b. Adequacy of Information

The information and data available were adequate for performance of this investigation.

c. Necessity of Additional Investigations

No additional investigations are required.

d. Urgency

The recommended measures 1 through 5 as described below must be taken within 1 year from notification.

7.2 RECOMMENDED MEASURES

The following are the recommended measures:

1. Removal of trash and debris from spillway channel.
2. Repair reservoir drain control works.
3. Remove vegetation from spillway crest and chute.
4. Repair cracked and deteriorating concrete on abutment spillway chute.
5. Back fill spillway chute wall and protect slope against erosion.
6. Provide a program of periodic inspection and maintenance of the dam and appurtenances including yearly operation and lubrication of the reservoir drain. Document this information for future references. Also develop an emergency action plan.

DRAWINGS

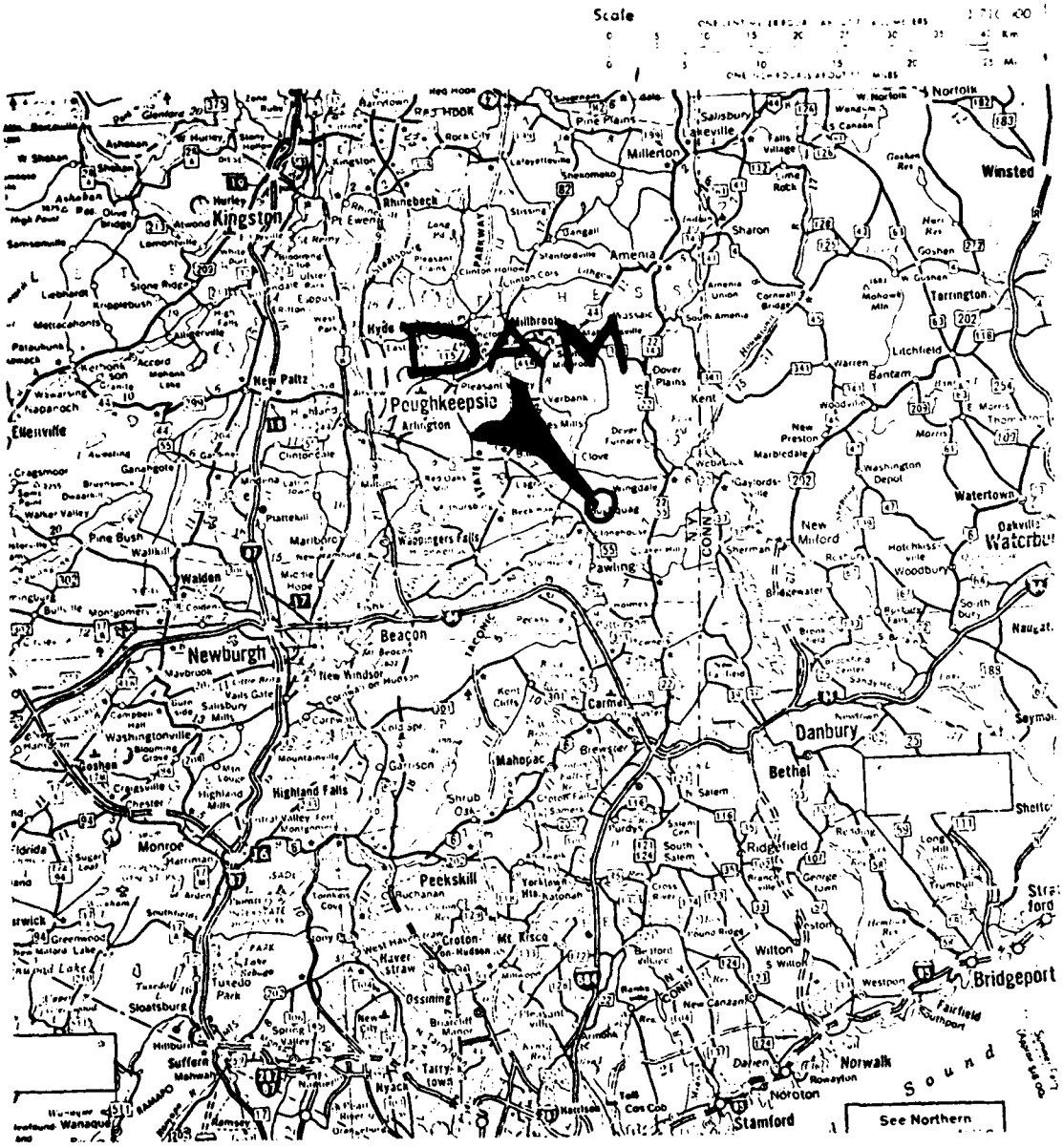
VICINITY MAP

TOPOGRAPHIC MAP

Plate 1. Layout of Dam
Plate 2. Section of Dam
Plate 3. Gatehouse
Plate 4. Spillway Section 0+74
Plate 5. Section at Gatehouse (See plate 3)
Plate 6. Section at Gatehouse (See plate 3)
Plate 7. Section along Dam Centerline
Plate 8. Section at Sta. 1+24

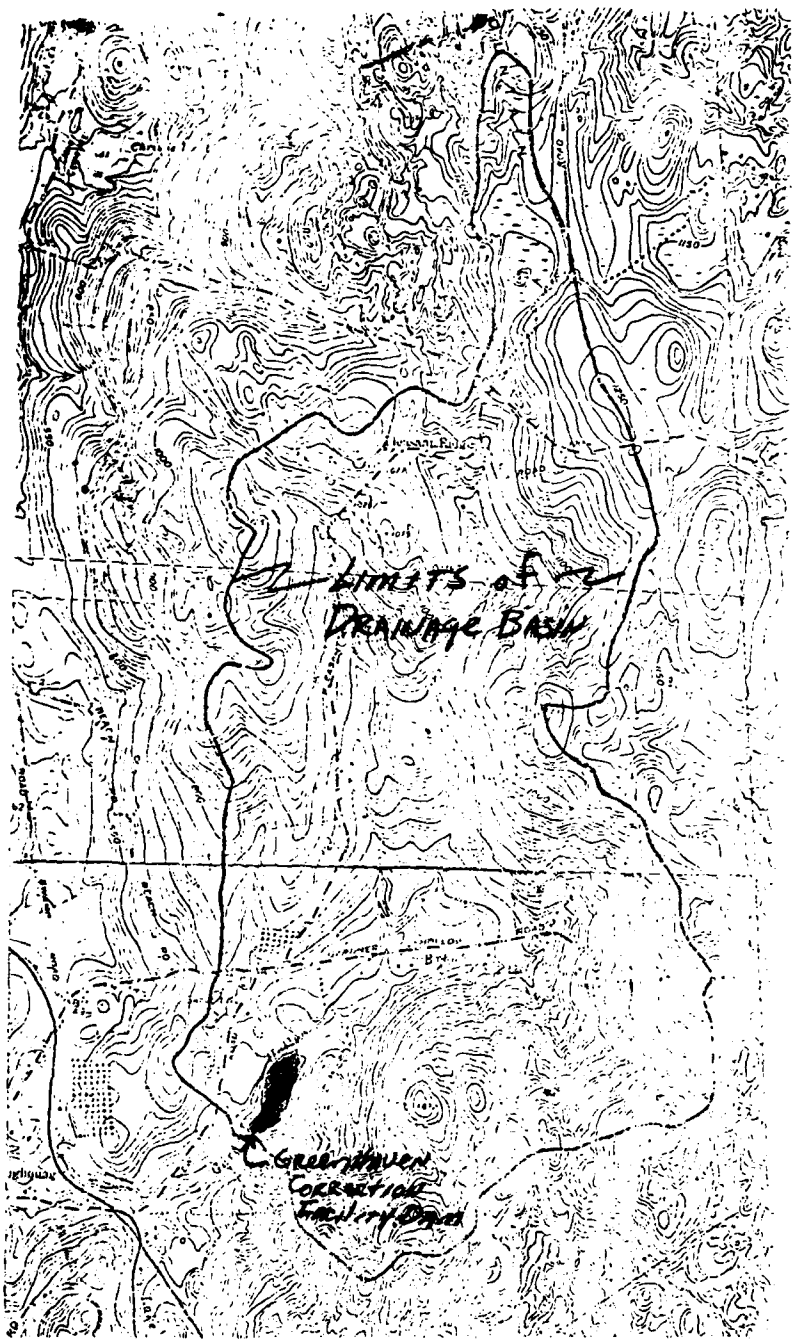
Note: Pertinent information regarding Dam , Spillway and Gatehouse were photographically reproduced and are included in the Appendix. The complete set of drawings are with the owner (See Section 2.3)

APPENDIX A



VICINITY MAP
GREENHAVEN CORRECTION FACILITY DAM

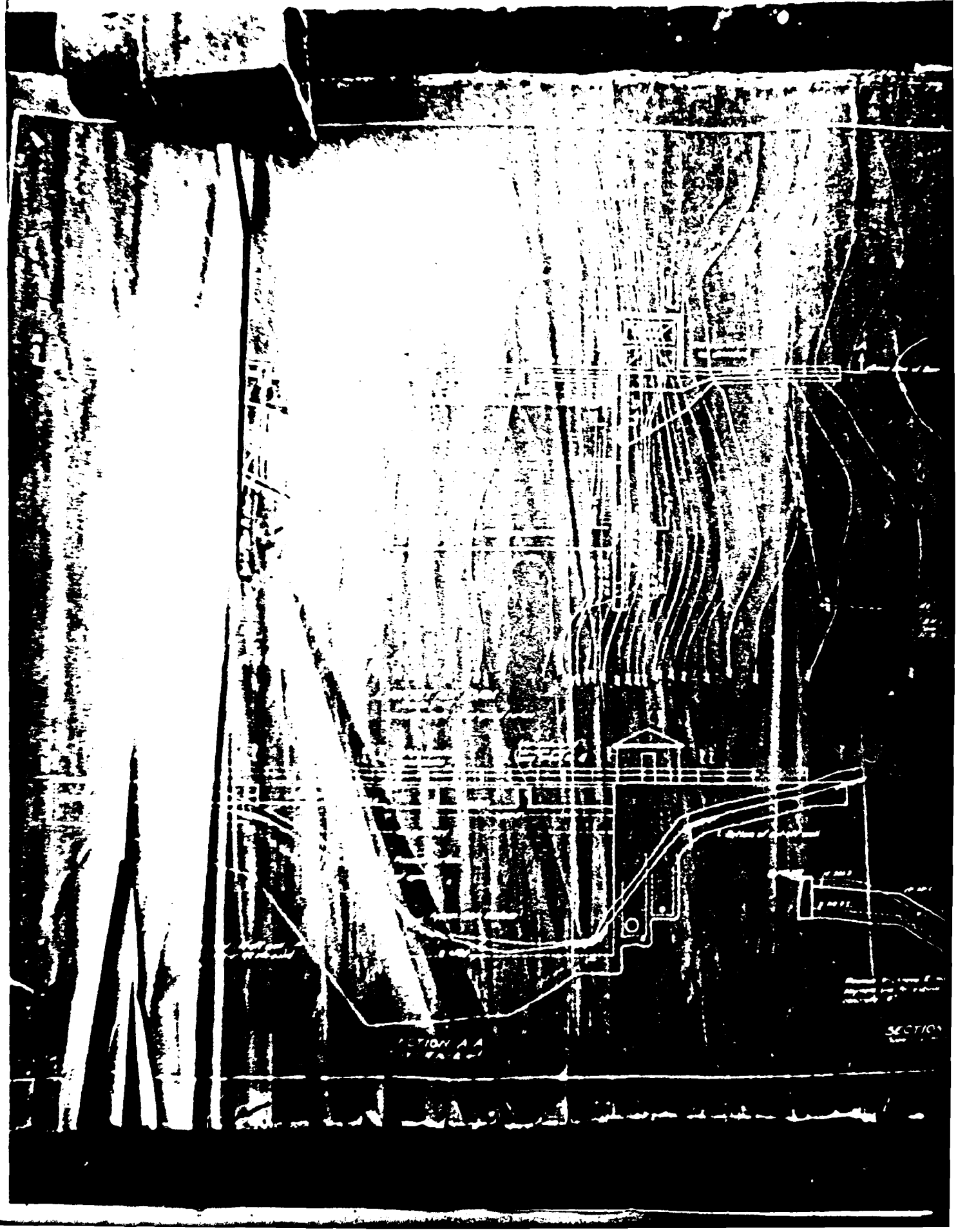
VERBANK, N.Y. QUAD.
POUGHQUAG, N.Y. QUAD

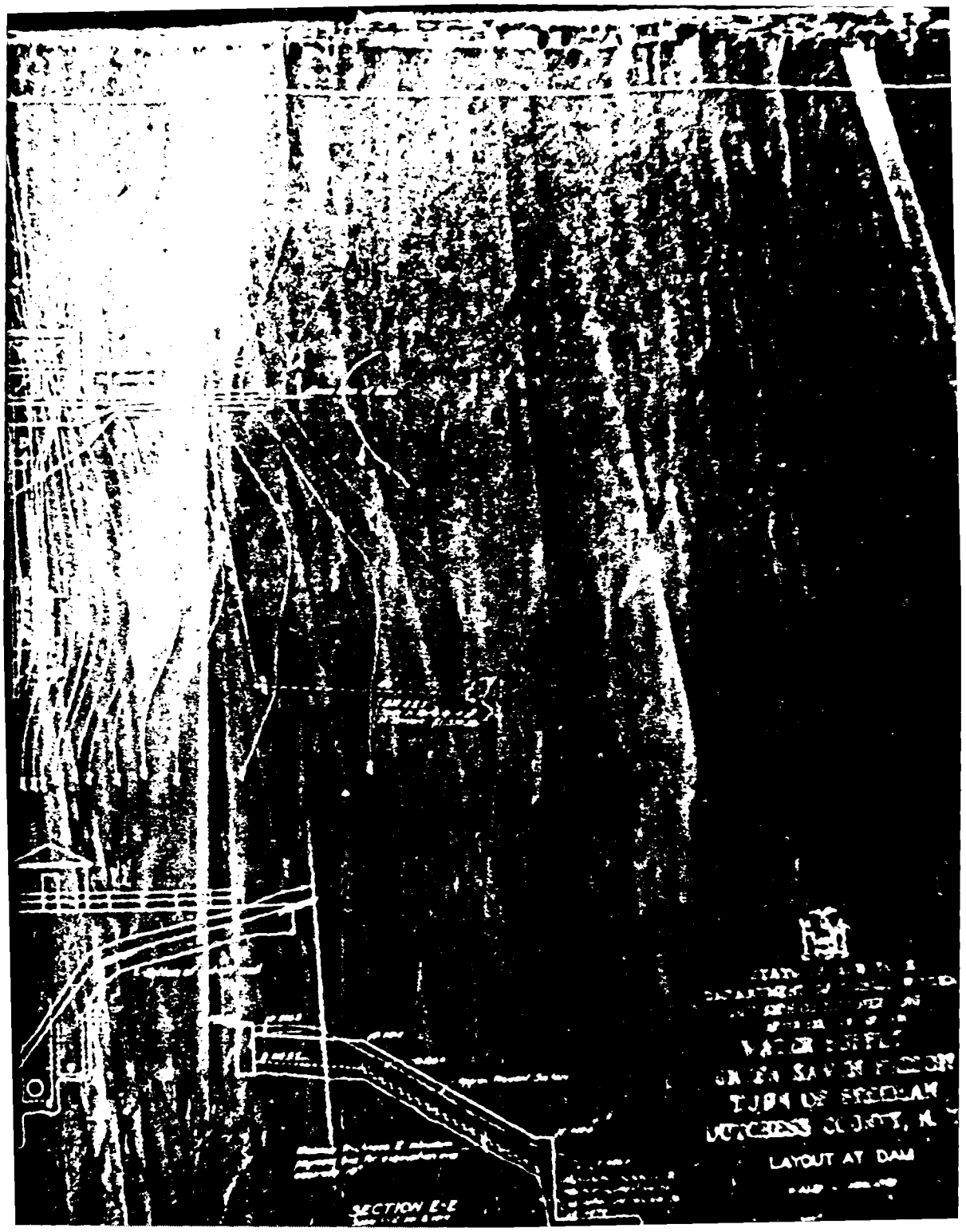


TOPOGRAPHIC MAP
GREENHAVEN CORRECTION FACILITY DAM

SCALE 1:24000

CONTOUR INTERVAL 10 FEET
DATUM IS MEAN SEA LEVEL

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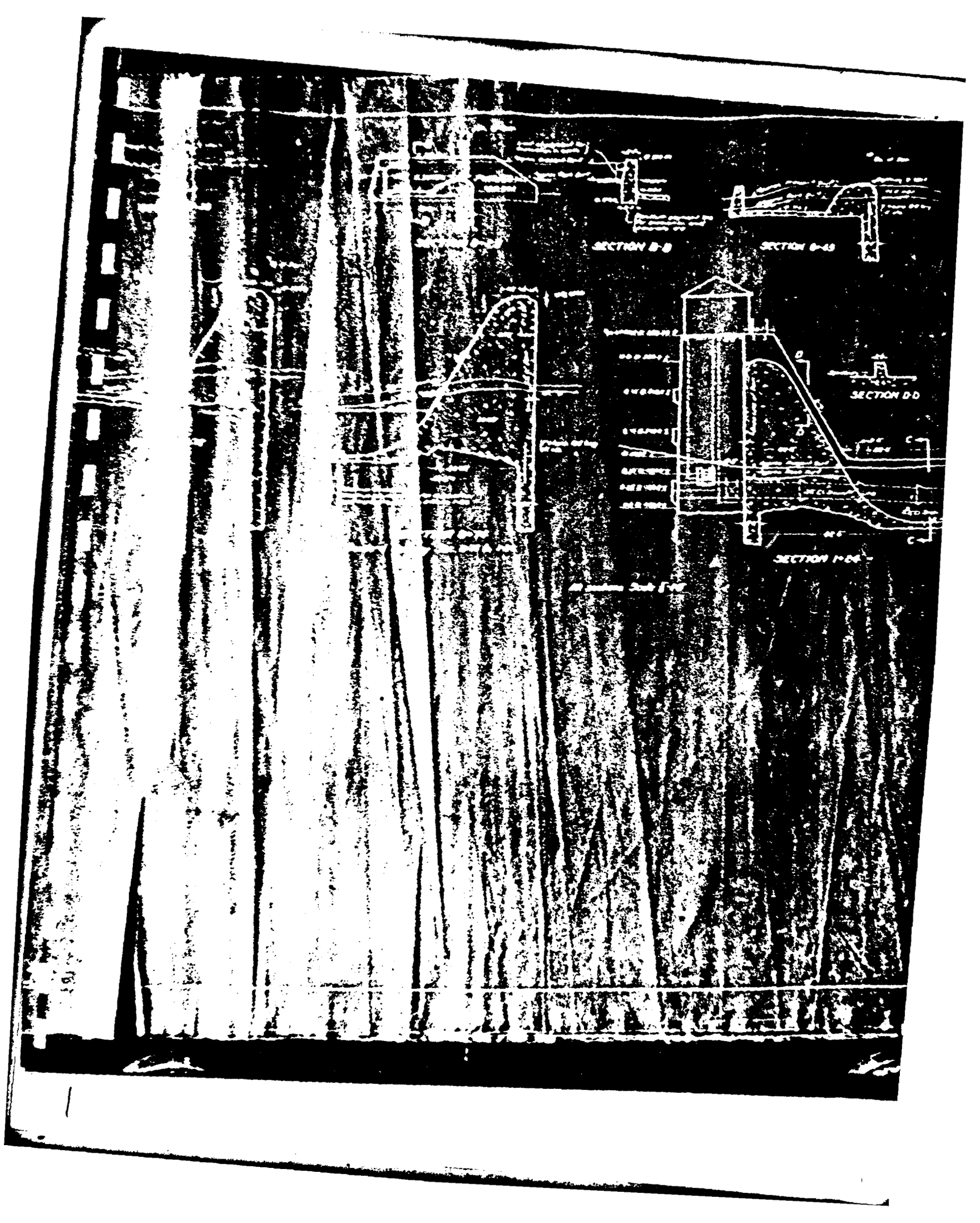
LAYOUT AT DAM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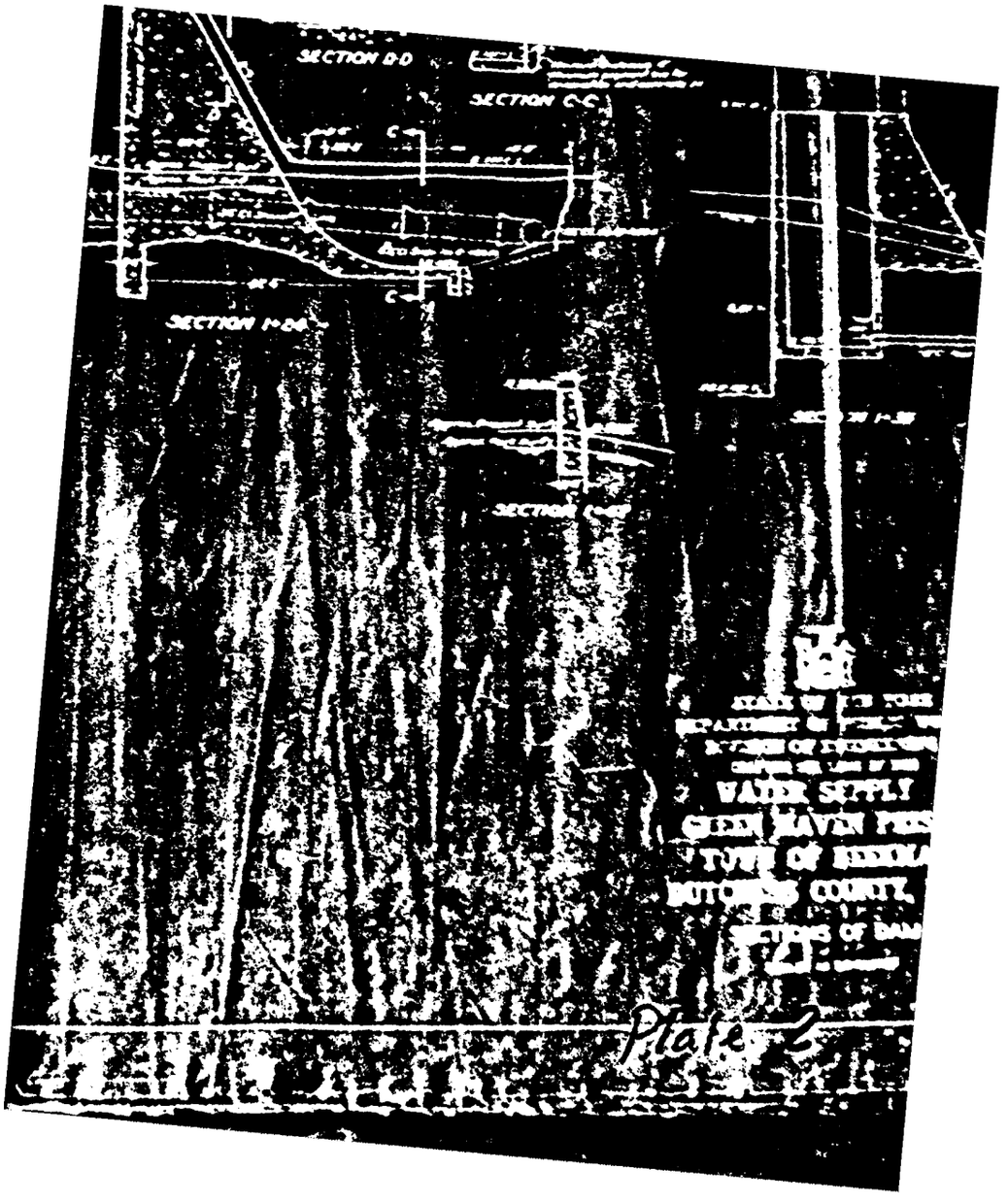
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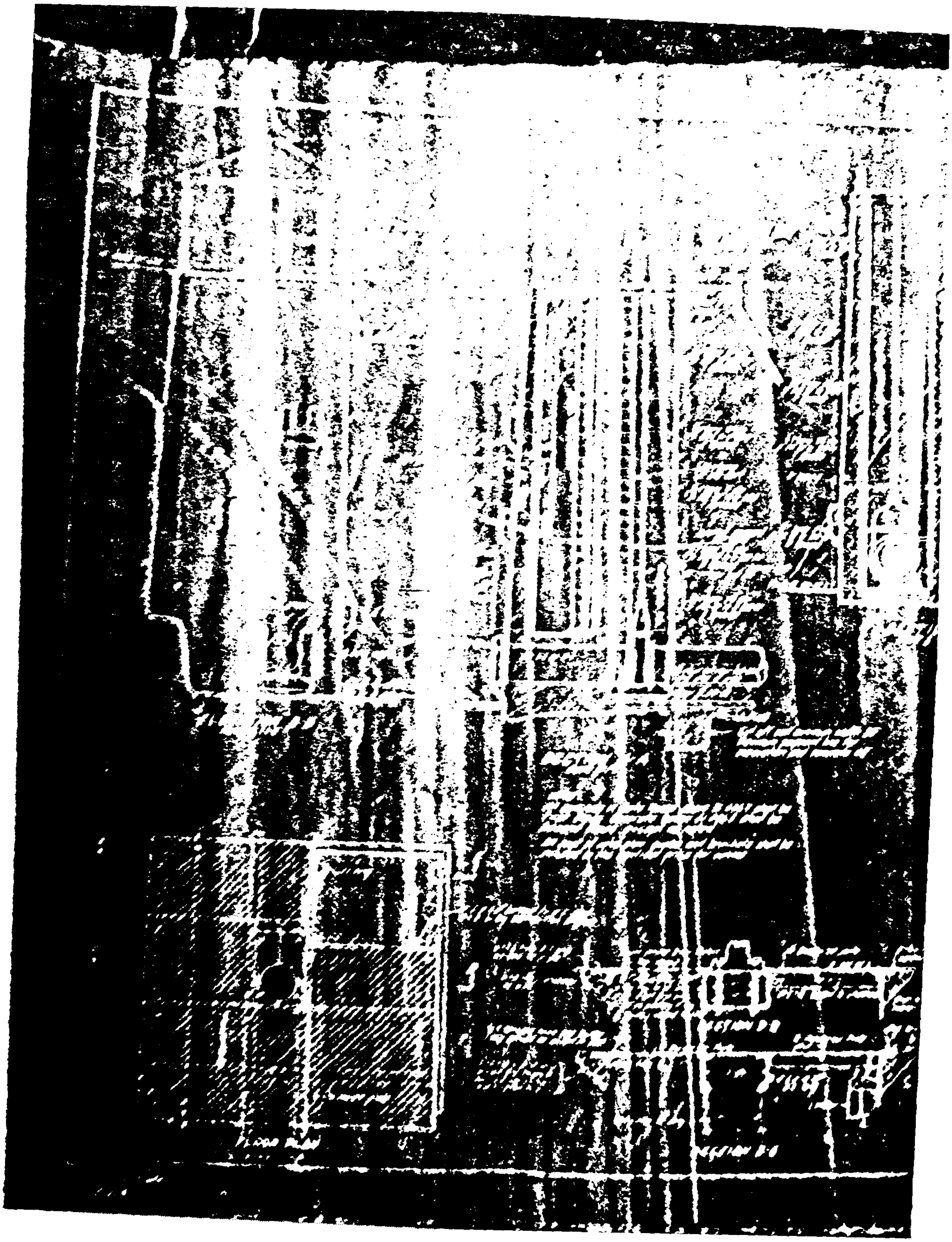
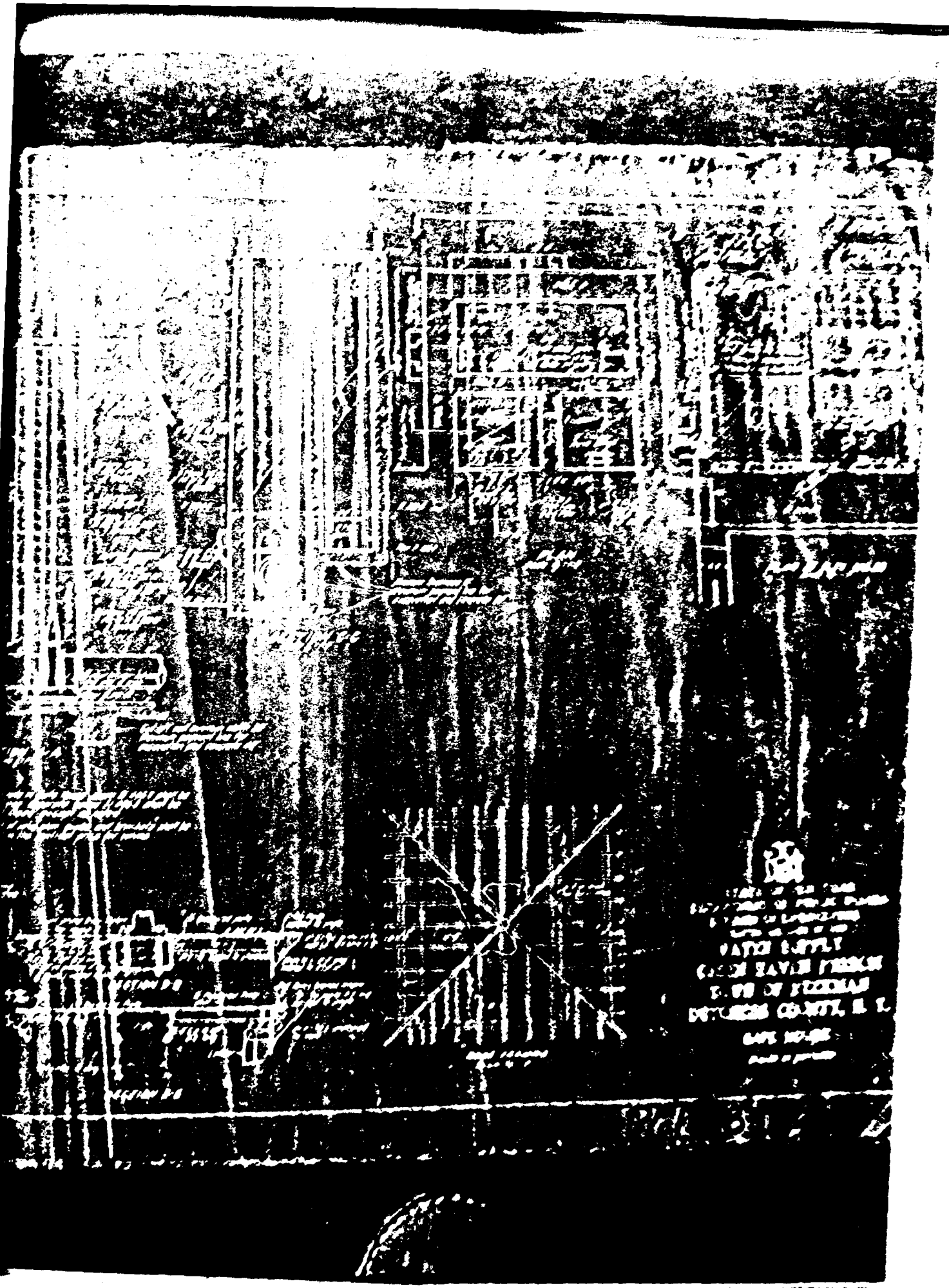
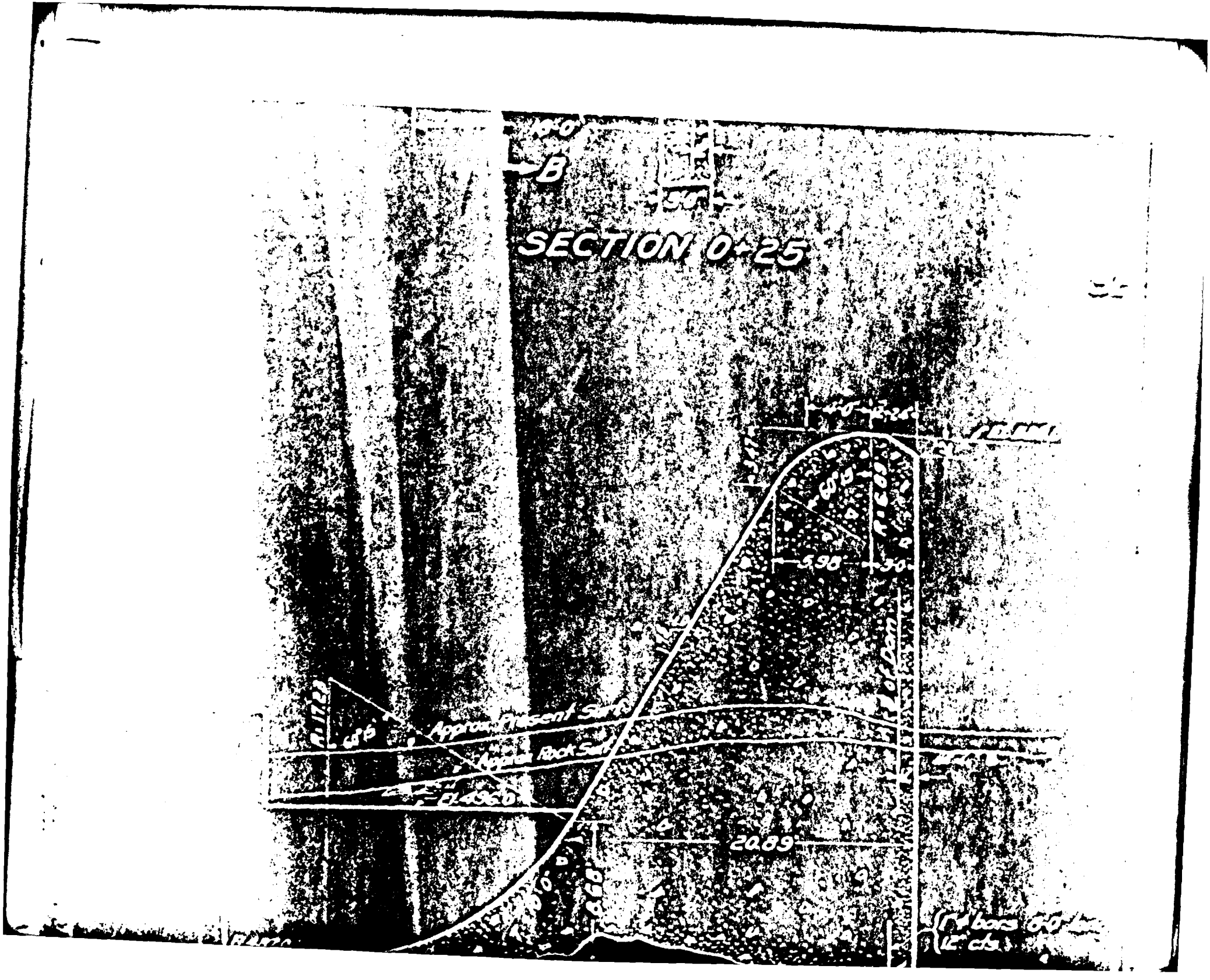
Plate 2






B
SECTION 0-25
590
2009

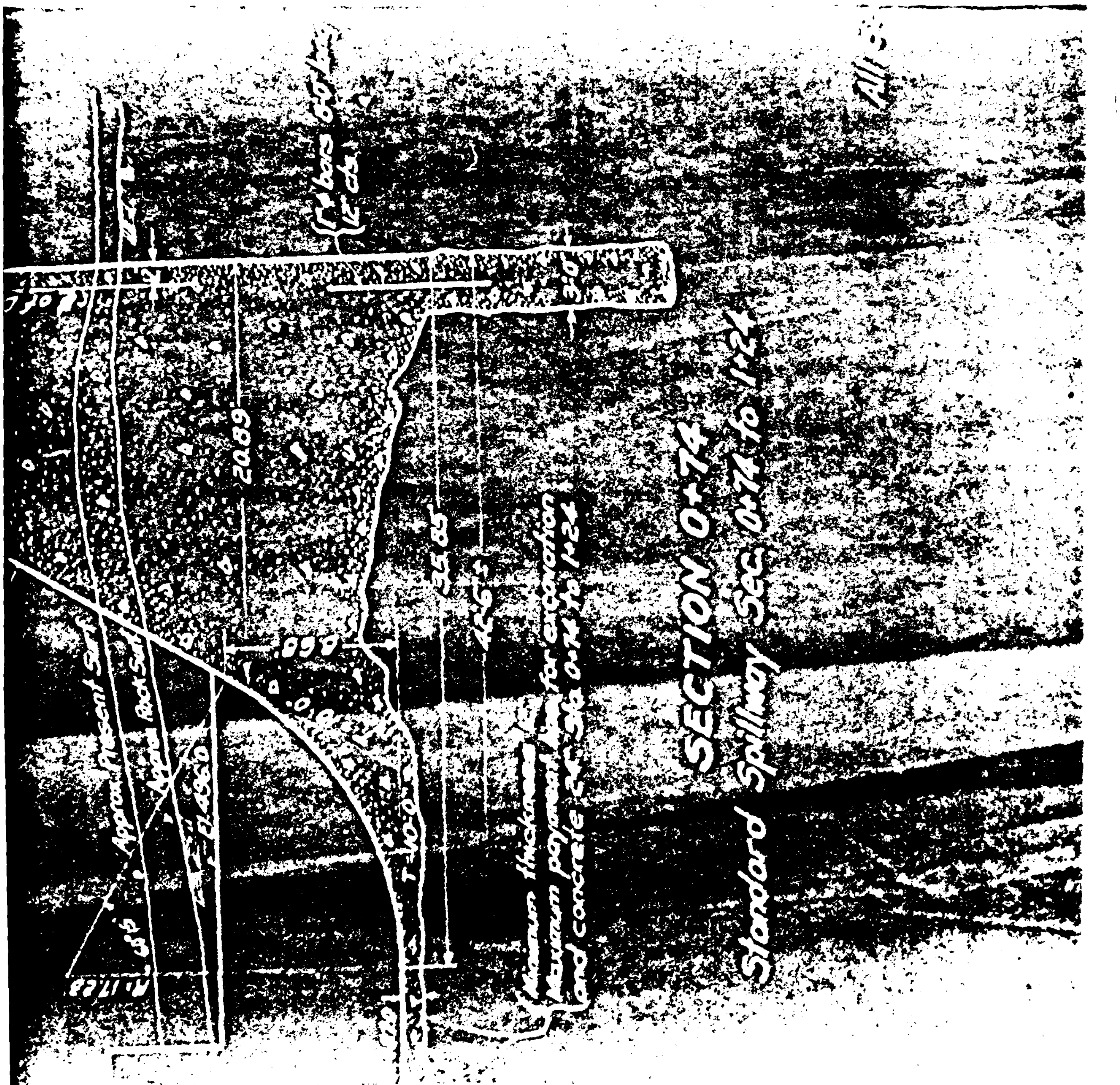
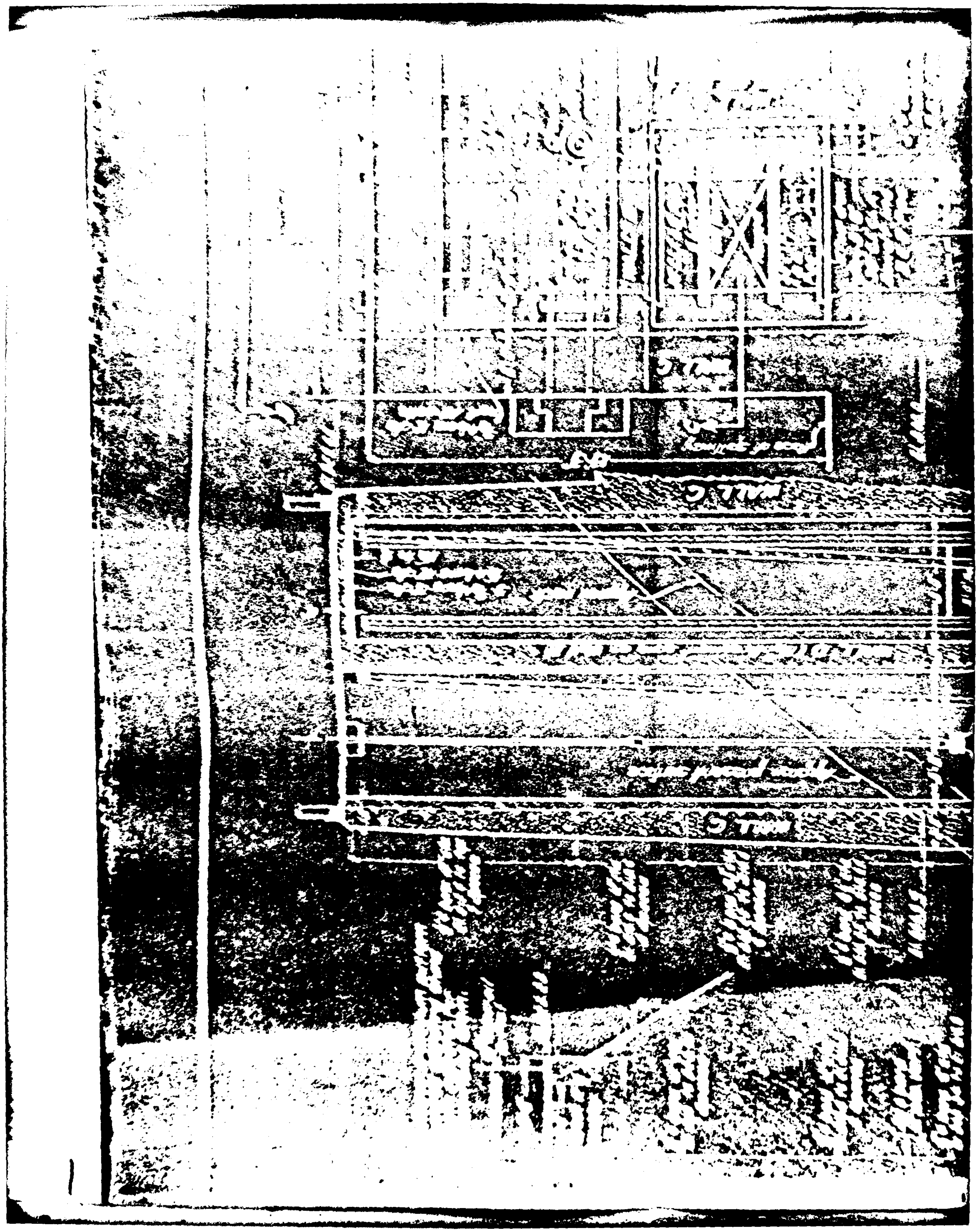
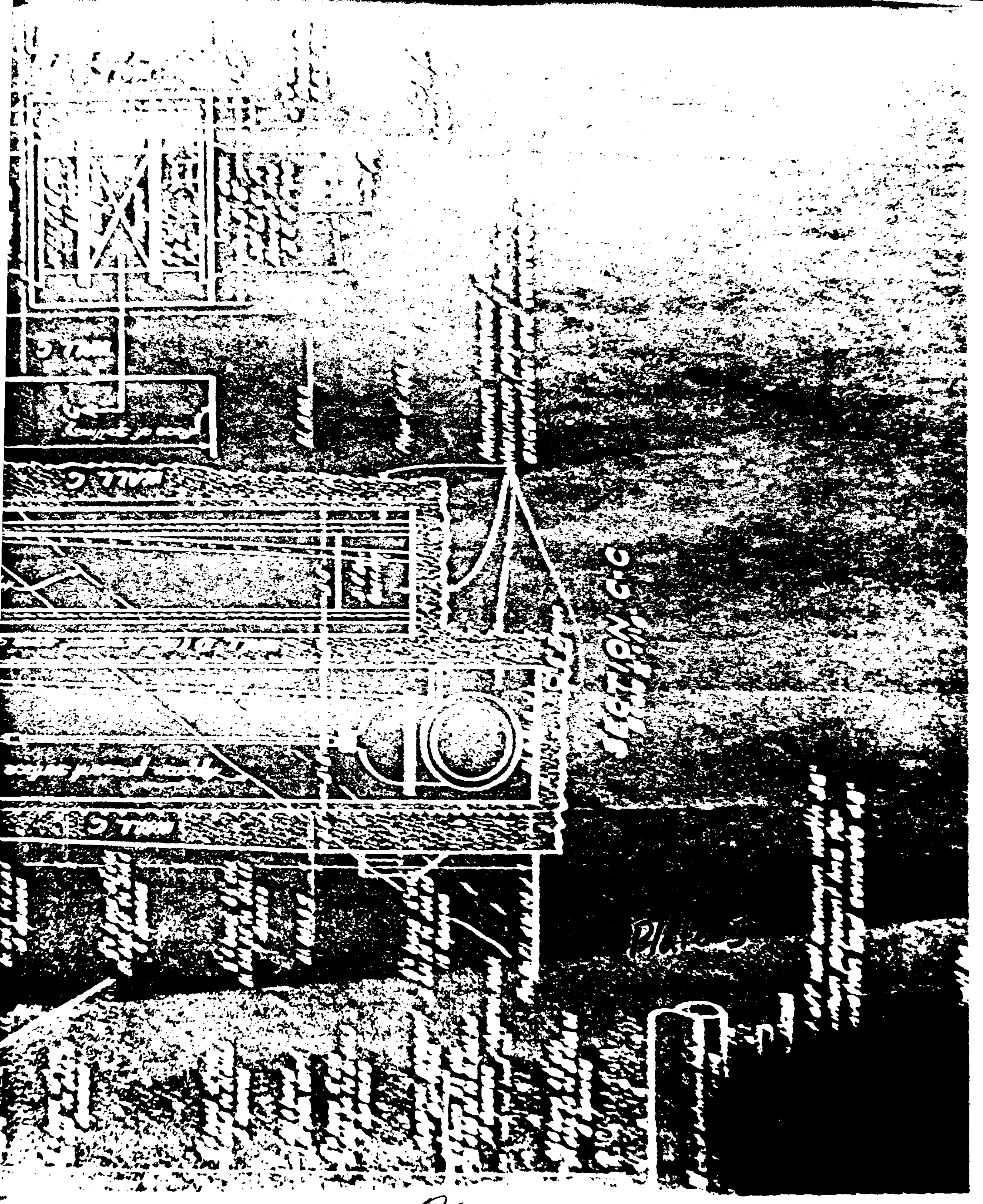


Plate 4




SECTION C-C

SECTION
Plate 6

SEC
Scale
NAD

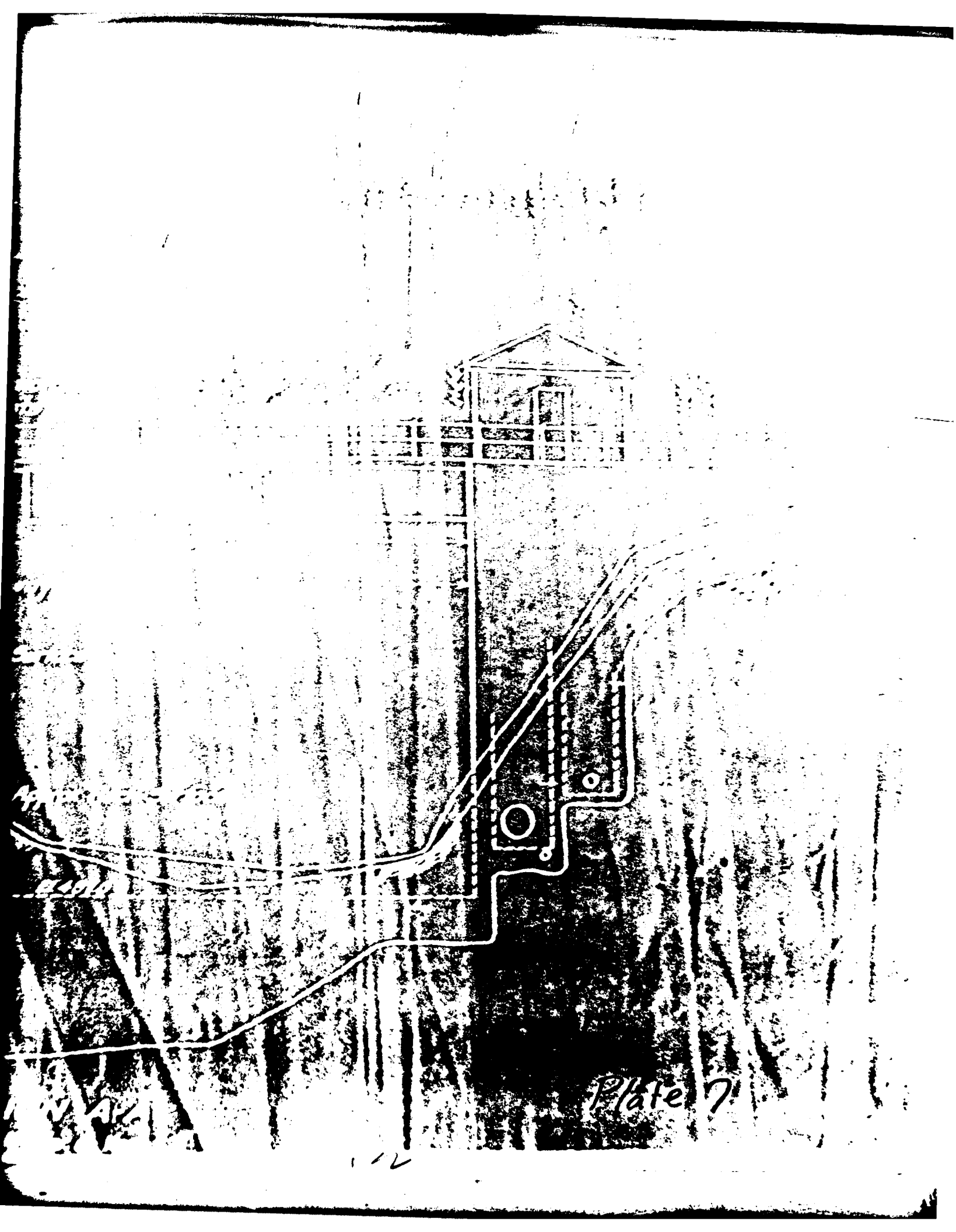
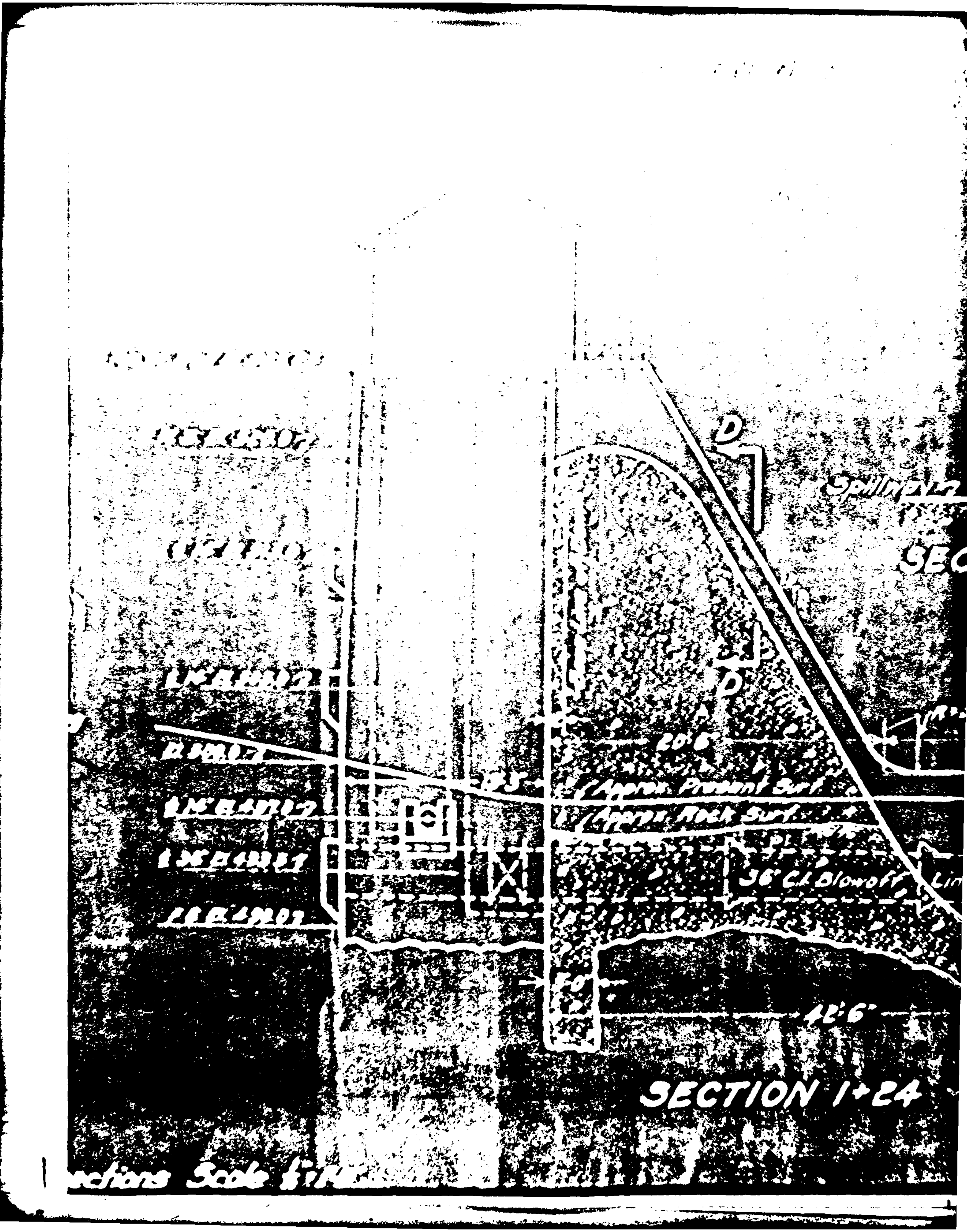
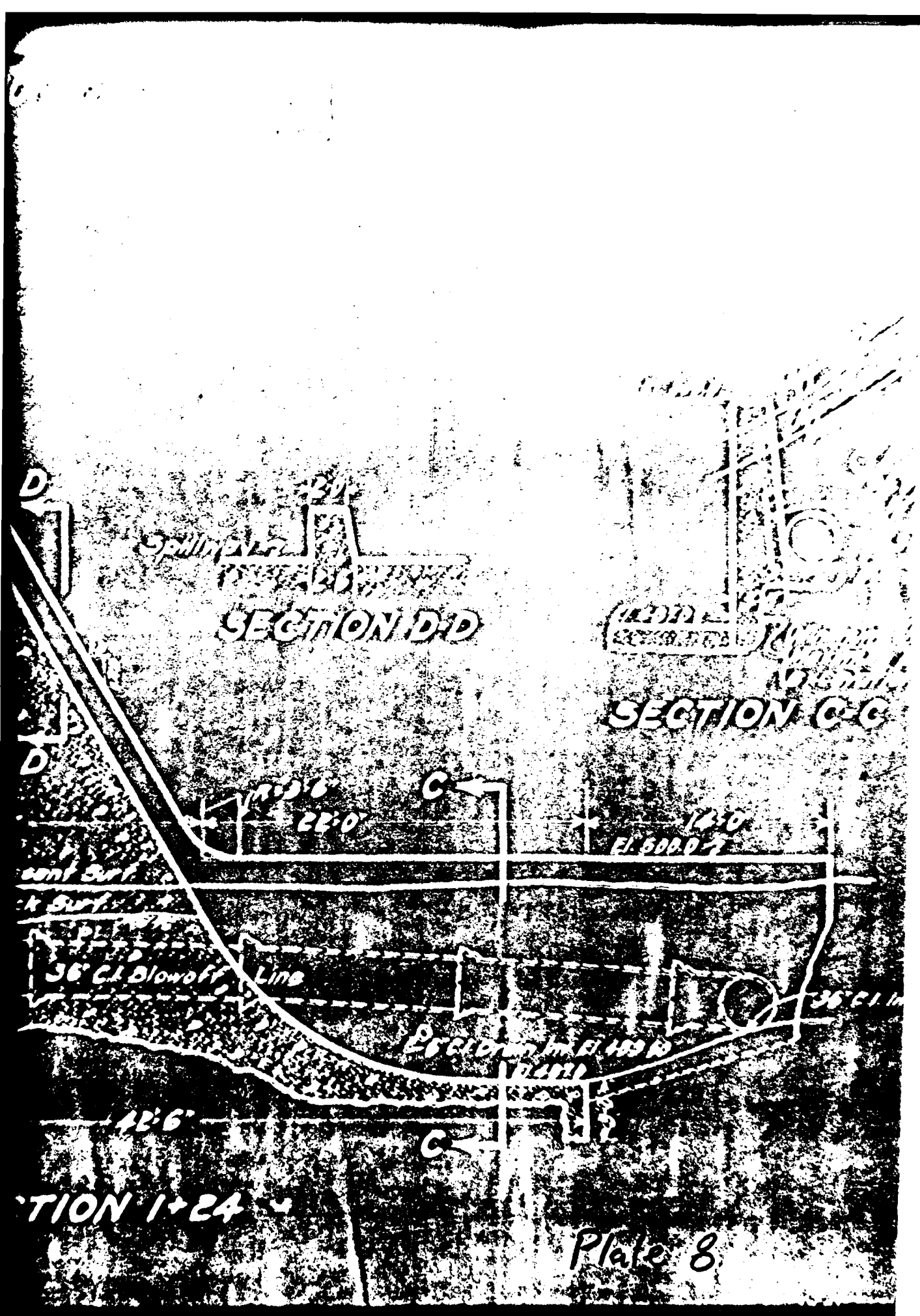


Plate 7


D
20'6"
Approx. Present Surf.
Approx. Rock Surf.
36" C.I. Blowoff
12'6"
SECTION 1+24


SECTION D-D
SECTION C-C
36" CI Blowoff Line
Plate 8

PHOTOGRAPHS

APPENDIX B

2) CENTERLINE VIEW OF DAM FROM LEFT ABUTMENT (NOTE UPPER LEVEL SPILLWAY CHUTE ON RIGHT ABUTMENT)

3) VIEW OF UPSTREAM FACE OF DAM FROM RIGHT ABUTMENT (NOTE LOCATION OF GATEHOUSE AT LEFT ABUTMENT)

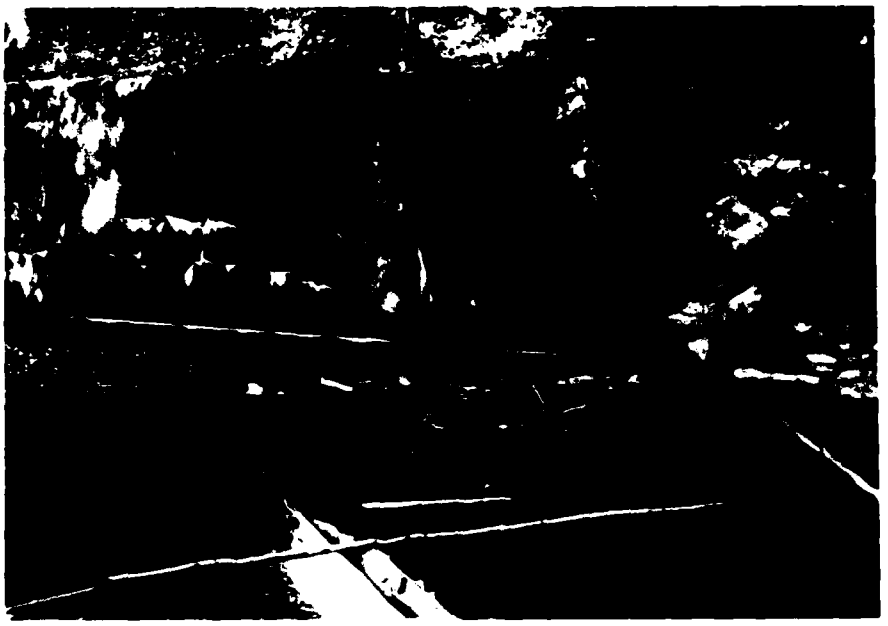
4) HIGH LEVEL SPILLWAY CHUTE ON RIGHT ABUTMENT - (NOTE CRACKING, SPALLING, GROWTH OF VEGETATION AND SEEPAGE AT INTERSECTION WITH DAM)

5) DOWNSTREAM WALL OF HIGH LEVEL SPILLWAY CHUTE (NOTE CRACKS AND EROSION)

6) GARDNER HOLLOW BROOK IMMEDIATELY DOWNSTREAM OF DAM

7) TYPICAL WALKWAY PIER ON DAM CREST-(NOTE MINOR SPALLING OF CONCRETE)

8) RESERVOIR DRAIN CONTROL (NOTE MISSING GEAR AND HANDLE ASSEMBLY)



9) RESERVOIR DRAIN OUTLET ON DOWNSTREAM LEFT ABUTMENT

VISUAL INSPECTION CHECKLIST

APPENDIX C

VISUAL INSPECTION CHECKLIST

1) Basic Data

a. General

Name of Dam Greenhaven Correction Facility Dam

Fed. I.D. # NY 01170 DEC Dam No. 230C-4123

River Basin Lower Hudson River

Location: Town Beekman County Dutchess

Stream Name Gaylord Hollow Brook

Tributary of Whaley Lake Stream

Latitude (N) 41°-36.7' Longitude (W) 073°-39.8'

Type of Dam Concrete Gravity

Hazard Category High

Date(s) of Inspection 8 July 1981

Weather Conditions Clear - Hot - 98°F

Reservoir Level at Time of Inspection 523.1

b. Inspection Personnel Harvey Feldman + John Weiler

c. Persons Contacted (Including Address & Phone No.) (914)-221-2711

Mr. Angelo Lonardo, Plant Superintendent, Greenhaven Correction Facility, New York State Department of Correction, Stormville, NY. 12582

d. History:

Date Constructed circa 1940 Date(s) Reconstructed Unknown

Designer New York State

Constructed By New York State

Owner NYS Department of Corrections

2) Embankment

a. Characteristics

(1) Embankment Material No Embankment

(2) Cutoff Type N/A

(3) Impervious Core N/A

(4) Internal Drainage System N/A

(5) Miscellaneous N/A

b. Crest

(1) Vertical Alignment N/A

(2) Horizontal Alignment N/A

(3) Surface Cracks N/A

(4) Miscellaneous N/A

c. Upstream Slope

(1) Slope (Estimate) (V:H) N/A

(2) Undesirable Growth or Debris, Animal Burrows N/A

(3) Sloughing, Subsidence or Depressions N/A

(4) Slope Protection N/A

(5) Surface Cracks or Movement at Toe N/A

d. Downstream Slope

(1) Slope (Estimate - V:H) N/A

(2) Undesirable Growth or Debris, Animal Burrows N/A

(3) Sloughing, Subsidence or Depressions N/A

(4) Surface Cracks or Movement at Toe N/A

(5) Seepage N/A

(6) External Drainage System (Ditches, Trenches; Blanket) N/A

(7) Condition Around Outlet Structure N/A

(8) Seepage Beyond Toe N/A

e. Abutments - Embankment Contact

N/A

(1) Erosion at Contact N/A

(2) Seepage Along Contact N/A

3) Drainage System

a. Description of System None

b. Condition of System N/A

c. Discharge from Drainage System N/A

4) Instrumentation (Momumentation/Surveys, Observation Wells, Weirs, Piezometers, Etc.) None Observed on Drawings

5) **Reservoir**

a. Slopes *Relatively flat and stable in general vicinity of the Dam*

b. Sedimentation *None observable*

c. Unusual Conditions Which Affect Dam *Frequent Vandalism of gatehouse*

6) **Area Downstream of Dam**

a. Downstream Hazard (No. of Homes, Highways, etc.) *Route 216 (~½ mile SSW) No houses or structures within ½ mile*

b. Seepage, Unusual Growth *None observed*

c. Evidence of Movement Beyond Toe of Dam *None observed*

d. Condition of Downstream Channel *fair - few fallen trees & debris partially block the brook*

7) **Spillway(s) (Including Discharge Conveyance Channel)**

bilevel Central overflow section downface of dam

a. General *flow through lower overflow section is directed down face of dam, upper level overflow is [illegible] in a [illegible] along the right abutment [illegible] & [illegible] the toe of the dam*

b. Condition of Service Spillway *good in general. Portion at right abutment secondary chute for upper level spillover has been repaired by gunite. Continuing cracking, spalling and breakage of the surface has resulted since its repair.*

c. Condition of Auxiliary Spillway NONE

d. Condition of Discharge Conveyance Channel Fair

8) Reservoir Drain/Outlet

Type: Pipe X Conduit _____ Other _____

Material: Concrete _____ Metal _____ Other C.I. / A

Size: 36" diam Length 65 feet

Invert Elevations: Entrance 481.5 Exit 475.5

Physical Condition (Describe): Unobservable _____

Material: UNOBSERVABLE

Joints: _____ Alignment _____

Structural Integrity: UNOBSERVABLE

Hydraulic Capability: _____

Means of Control: Gate X Valve _____ Uncontrolled _____

Operation: Operable _____ Inoperable _____ Other X

Present Condition (Describe): Reported by operating personnel
Valve was missing as a result of [illegible]

9) Structural

a. Concrete Surfaces Minor spalling of cross walk piers, training wall of Right upper level chute and cracked with PORTIONS of GUNITE RESURFACEING AT toe MISSING

b. Structural Cracking NONE OBSERVABLE ON DAM

c. Movement - Horizontal & Vertical Alignment (Settlement) NO SIGNIFICANT MOVEMENT could be observed

d. Junctions with Abutments or Embankments GOOD - NO EROSION observed

e. Drains - Foundation, Joint, Face N.O.L.C.

f. Water Passages, Conduits, Sluices N.A.

g. Seepage or Leakage MINOR SEEPAGE ON FACE OF Upper Level Spillway Chute

h. Joints - Construction, etc. Appear good

i. Foundation cutoff wall keyed into bedrock

j. Abutments Rock

k. Control Gates Reservoir drain is reportedly inoperable, condition- Main spillway is concrete lined

l. Approach & Outlet Channels No Approach Channel - Outlet Channel is downstream natural channel of Gulnick Hollow Brook- partially blocked by fallen trees and their roots

m. Energy Dissipators (Plunge Pool, etc.) N/A

n. Intake Structures Unobservable

o. Stability Appears Stable

p. Miscellaneous

10) Appurtenant Structures (Powerhouse,Lock,Gatehouse,Other)

a. Description and Condition For description of spillway, see Section 7.

HYDROLOGIC DATA AND COMPUTATIONS

APPENDIX. D

CHECK LIST FOR DAMS
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

AREA-CAPACITY DATA:

	Elevation (ft.)	Surface Area (acres)	Storage Capacity (acre-ft.)
1) Top of Dam	525.25	23.5	322
2) Design High Water (Max. Design Pool)	UNKNOWN	—	—
3) Auxiliary Spillway Crest	~~N/A~~	—	—
4) Pool Level with Flashboards	~~N/A~~	—	—
5) Service Spillway Crest	Low Lvl 520.0 · High Lvl 520.5	12.7	240

DISCHARGES

	Volume (cfs)
1) Average Daily	UNKNOWN
2) Spillway @ Maximum High Water	3324
3) Spillway @ Design High Water	N/A
4) Spillway @ Auxiliary Spillway Crest Elevation	N/A
5) Low Level Outlet	Unknown
6) Total (of all facilities) @ Maximum High Water	3324+
7) Maximum Known Flood	UNKNOWN
8) At Time of Inspection	UNKNOWN

DAM
CREST: ELEVATION: 525.25

Type: Concrete Gravity

Width: 6 feet Lengt': 176'

Spillover Central Gilboa uncontrolled overflow section

Location Center of Dam

SPILLWAY:

SERVICE		AUXILIARY
Invert 520.0 Highland 520.5	Elevation	—
Uncontrolled overflow section	Type	NONE
100'	Width	—
	Type of Control	
✓	Uncontrolled	
	Controlled:	
—	Type (Flashboards; gate)	
—	Number	
—	Size/Length	
	Invert Material	
	Anticipated Length of operating service	
60 feet	Chute Length	
N/A	Height Between Spillway Crest & Approach Channel Invert (Weir Flow)	

HYDROMETEROLOGICAL GAGES:

Type : NONE

Location: —

Records:

Date - —

Max. Reading - —

FLOOD WATER CONTROL SYSTEM:

Warning System: NONE

Method of Controlled Releases (mechanisms):

NONE

DRAINAGE AREA: 4.45 sq. miles

DRAINAGE BASIN RUNOFF CHARACTERISTICS:

Land Use - Type: Farming

Terrain - Relief: moderately to gently sloping

Surface - Soil: Loam

Runoff Potential (existing or planned extensive alterations to existing (surface or subsurface conditions)

Potential Sedimentation problem areas (natural or man-made; present or future)

None

Potential Backwater problem areas for levels at maximum storage capacity including surcharge storage:

None

Dikes - Floodwalls (overflow & non-overflow) - Low reaches along the Reservoir perimeter:

Location: None

Elevation:

Reservoir:

Length @ Maximum Pool 0.36 (Miles)

Length of Shoreline (@ Spillway Crest) 0.68 (Miles)

TAMS

Job No. 1579-20 Sheet 1 of 18
Project GREENHAVEN CORRECTIONAL FACILITY RES. Date JUL. 21, 81
Subject HYDROLOGIC / HYDRAULIC COMPUTATIONS By D.L.C.
HUC # 02020008 Ch'k. by

SNYDER'S COEF: $C_T = 2.0$

$C_p = 0.625$.

$T_p = C_T (L L_{CA})^{0.3}$.

$L = 8.5" = 17{,}000 ft = 3.22$ miles

$L_{CA} = 3.0" \quad 6{,}000 ft = 1.14$ miles.

$T_p = 2.0(3.22 \times 1.14)^{0.3}$

$= 2.95$

$t_r = 2.95/5.5 = 0.536$

Use $t_R = 0.50$.

$t_{PR} = t_p + 0.25(t_R - t_r)$

$= 2.95 - 0.01$

$= 2.94$ hours.

INITIAL LOSS = 1.0 inch.

Constant loss = 0.1 inch/hour.

LAKE Area = 14.7 ac.

D/Area = 2850 ac.

% Impervious = 0.5 %

TAMS

Job No. _____ Sheet 2 of 18
Project GREENHAVEN CORRECTIONAL FACILITY DAM. Date July 21, 81
Subject HYDROLOGIC/HYDRAULIC COMPUTATIONS By D.L.C.
Ch'k. by _____

SPILLWAY RATING.

Effective length @ crest EL. 520 = 45.0'
Effective length @ crest EL. 520.5 = 45.0'
TOP of DAM EL. 523.5.
WALKWAY OVER SPILLWAY assumed 'washed out' during PMF Analysis. USE C = 3.3.

EL.	H_1	Q_1	H_2	Q_2	Q_{TOTAL}
520	0		—		0
520.5	0.5	52.5	0	0	52.5
521.5	1.5	272.8	1	148.5	421.3
523.5	3.5	972.4	3	771.6	1744.0
525.25	5.25	1786.3	4.75	1537.3	3323.6
530.0	10.0	4696.	9.5	4348.	9044

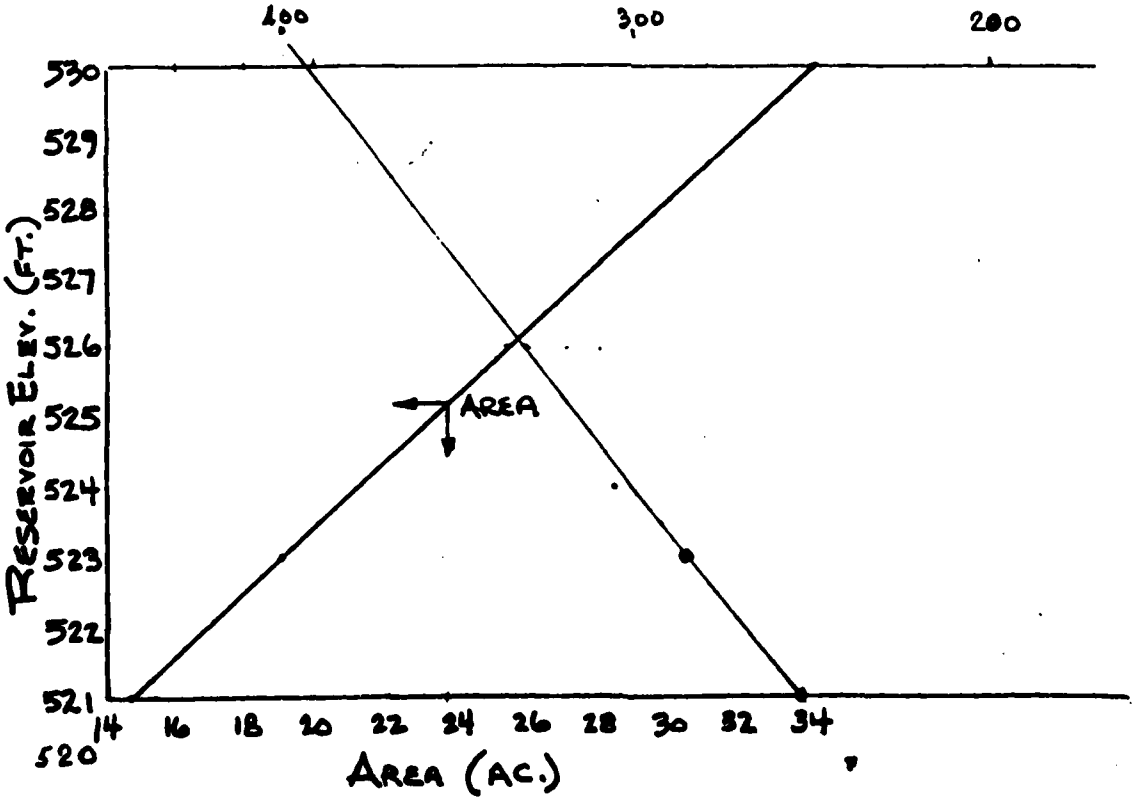
DAM LENGTH = 165.0'
USE C = 2.8 for top of dam.
FROM HYDROMET #33 Zone 1
ALL SEASON 200 SQ MI 24 HR PMP = 21.2 inches

DURATION (HRS)	6	12	24	48
% PMP depth.	112	125	133	141

TAMS

Job No. 1579-20 Sheet 3 of 18
Project GREEN HAVEN C.F. RESERVOIR Date 7/81
Subject _____ By JMD
_____ Ch'k. by _____

Elev. (ft.)	ΔH (ft.)	Area (Ac.)	Mean Area (Ac.)	Inc. Vol. (Ac.-Ft.)	Surcharge Storage (Ac.-Ft.)
520		13.7			0
521		14.7			13.7
	1		15.75	15.8	
522		16.8			29.5
	1		17.9	17.9	
523		19.0			47.4
	1		20.05	20.1	
524		21.1			67.5
	2		23.25	23.3	
526		25.4			90.8
	2		27.55	27.6	
528		29.7			
	2		31.85	31.9	
530		34.0			150.3



TAMS

Job No. 1579-20 Sheet 4 of 18
Project GREEN HAVEN CORRECTIONAL FACILITY RESERVOIR Date 7/81
Subject _____ By JMD
_____ Ch'k. by _____

FETCH: 1900' = 0.36 mi

PERIMETER (@ EL. 521): 1.8" = 0.68 mi.

LAKE AREA (@EL. 521): 0.16 in² (4 out of 9 measurings)

14.7 AC = 0.023 mi²

CONTOUR (@ EL. 530): 0.36
0.38
0.37
0.37
avg = 0.37 in² ⇒ 34.0 AC. = 0.053 mi²

DRAINAGE AREA:

14.01	} POUGHQUAG QUAD		17.5	} VERBANK QUAD
14.00			16.7	
13.99			16.9	
avg = 14.0 in²			avg = 17.033 in²	

1285.6 ac. + 1564.1 ac. ≅ 2850 AC.
= 4.45 mi²

TAMS

Job No. 1579-20 Sheet 5 of 18

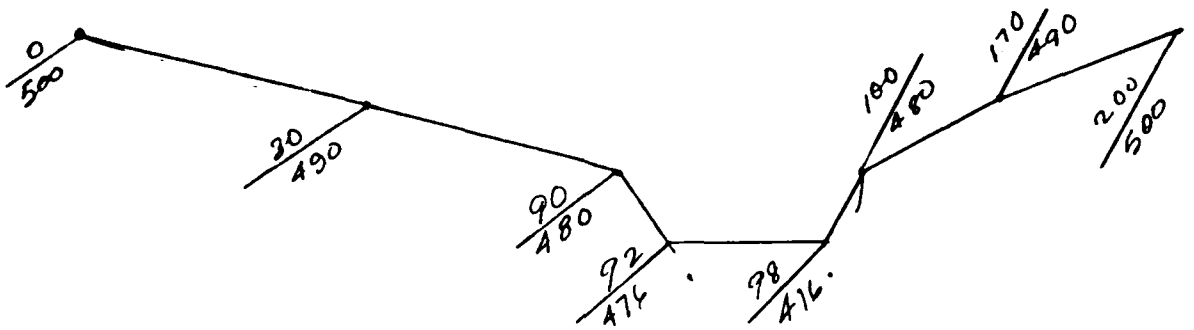
Project GREENHAVEN CORRECTIONAL FACILITY RESERVOIR. Date JULY 22, 1981

Subject HYDROLOGIC/HYDRAULIC COMPUTATIONS. By D.L.C.

Ch'k. by

Channel Cross Section. -

800 ft downstream of dam



```
**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  01 APR 80
**********************************
     1            A1               GREENHAVEN CORRECTIONAL FACILITY RESERVOIR         157920
     2            A2               PHASE 1 DAM SAFETY INSPECTION
     3            A3               HEC-1DB PMF ANALYSIS
     4            B    100       0      30       0       0       0       0       0       0       0
     5            B1     5
     6            J      1       4       1
     7            J1     1    0.75     0.5    0.25
     8            K              1                               1
     9            K1      1 INFLOW HYDROGRAPH
    10            M      1       1    4.45            4.45                               1
    11            P           21.2     112     123     133     141
    12            T                                              1     0.1           0.005
    13            W   2.94   0.625
    14            X     -1     -.1     1.5
    15            K      1       2                               1
    16            K1      2 ROUTE HYDROGRAPH THROUGH RESERVOIR
    17            Y                              1       1
    18            Y1     1                                     240      -1
    19            Y4   520   520.5   521.5   523.5  525.25     530
    20            Y5     0    52.5   421.3    1744  3323.6    9044
    21            $S   240   253.7   287.4   307.5   330.8   390.3
    22            $E   520     521     523     524     526     530
    23            $$   520
    24            $D525.25     2.8     1.5     176
    25            K      1       3
    26            K1      3 CHANNEL ROUTE  AT SECTION 800 FT BELOW DAM
    27            Y                              1       1
    28            Y1     1
    29            Y6 0.035   0.035   0.035     476     500     800    .014
    30            Y7     0     500      30     490      90     480      92     476      98     477
    31            Y7   100     460     170     490     200     500
    32            K     99
```

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  01 APR 80
**********

RUN  DATE= 81/07/28.
     TIME= 11.02.18.
```

GREENHAVEN CORRECTIONAL FACILITY RESERVOIR 157920
PHASE 1 DAM SAFETY INSPECTION
HEC-1DB PMF ANALYSIS

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
100	0	30	0	0	0	0	0	0	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 4 LRTIO= 1
RTIOS= 1.00 .75 .50 .25

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

1 INFLOW HYDROGRAPH

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	4.45	0.00	4.45	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	21.20	112.00	123.00	133.00	141.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.10	0.00	.01

UNIT HYDROGRAPH DATA
TP= 2.94 CP= .63 NTA= 0

RECESSION DATA
STRTQ= -1.00 QRCSN= -.10 RTIOR= 1.50
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 6.67 AND R= 5.36 INTERVALS

UNIT HYDROGRAPH 32 END-OF-PERIOD ORDINATES, LAG= 2.93 HOURS, CP= .63 VOL= 1.00

40.	147.	290.	441.	560.	618.	599.	519.	431.	357.
296.	246.	204.	169.	140.	116.	97.	80.	66.	55.

46. 38. 31. 26. 22. 18. 15. 12. 10. 8.
7. 6.

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.30	1	.00	.00	.00	4.	1.02	1.30	51	.06	.01	.05	12.
1.01	1.00	2	.00	.00	.00	4.	1.02	2.00	52	.06	.01	.05	13.
1.01	1.30	3	.00	.00	.00	4.	1.02	2.30	53	.06	.01	.05	16.
1.01	2.00	4	.00	.00	.00	4.	1.02	3.00	54	.06	.01	.05	19.
1.01	2.30	5	.00	.00	.00	4.	1.02	3.30	55	.06	.01	.05	23.
1.01	3.00	6	.00	.00	.00	4.	1.02	4.00	56	.06	.01	.05	25.
1.01	3.30	7	.00	.00	.00	3.	1.02	4.30	57	.06	.01	.05	28.
1.01	4.00	8	.00	.00	.00	3.	1.02	5.00	58	.06	.01	.05	30.
1.01	4.30	9	.00	.00	.00	3.	1.02	5.30	59	.06	.01	.05	31.
1.01	5.00	10	.00	.00	.00	3.	1.02	6.00	60	.06	.01	.05	33.
1.01	5.30	11	.00	.00	.00	3.	1.02	6.30	61	.16	.11	.05	38.
1.01	6.00	12	.00	.00	.00	3.	1.02	7.00	62	.16	.11	.05	53.
1.01	6.30	13	.01	.00	.01	3.	1.02	7.30	63	.16	.11	.05	83.
1.01	7.00	14	.01	.00	.01	3.	1.02	8.00	64	.16	.11	.05	127.
1.01	7.30	15	.01	.00	.01	3.	1.02	8.30	65	.16	.11	.05	183.
1.01	8.00	16	.01	.00	.01	2.	1.02	9.00	66	.16	.11	.05	244.
1.01	8.30	17	.01	.00	.01	2.	1.02	9.30	67	.16	.11	.05	304.
1.01	9.00	18	.01	.00	.01	2.	1.02	10.00	68	.16	.11	.05	355.
1.01	9.30	19	.01	.00	.01	2.	1.02	10.30	69	.16	.11	.05	398.
1.01	10.00	20	.01	.00	.01	2.	1.02	11.00	70	.16	.11	.05	434.
1.01	10.30	21	.01	.00	.01	2.	1.02	11.30	71	.16	.11	.05	463.
1.01	11.00	22	.01	.00	.01	2.	1.02	12.00	72	.16	.11	.05	488.
1.01	11.30	23	.01	.00	.01	2.	1.02	12.30	73	.95	.90	.05	540.
1.01	12.00	24	.01	.00	.01	2.	1.02	13.00	74	.95	.90	.05	674.
1.01	12.30	25	.06	.00	.06	2.	1.02	13.30	75	1.14	1.09	.05	926.
1.01	13.00	26	.06	.00	.06	2.	1.02	14.00	76	1.14	1.09	.05	1316.
1.01	13.30	27	.07	.00	.07	2.	1.02	14.30	77	1.42	1.37	.05	1836.
1.01	14.00	28	.07	.00	.07	2.	1.02	15.00	78	1.42	1.37	.05	2461.
1.01	14.30	29	.09	.00	.09	2.	1.02	15.30	79	1.73	1.68	.05	3145.
1.01	15.00	30	.09	.00	.09	2.	1.02	16.00	80	5.49	5.44	.05	4001.
1.01	15.30	31	.10	.00	.10	2.	1.02	16.30	81	1.33	1.28	.05	5095.
1.01	16.00	32	.33	.01	.32	3.	1.02	17.00	82	1.33	1.28	.05	6272.
1.01	16.30	33	.08	.03	.05	5.	1.02	17.30	83	1.04	.99	.05	7373.
1.01	17.00	34	.08	.03	.05	11.	1.02	18.00	84	1.04	.99	.05	8203.
1.01	17.30	35	.06	.01	.05	21.	1.02	18.30	85	.08	.04	.05	8601.
1.01	18.00	36	.06	.01	.05	32.	1.02	19.00	86	.08	.04	.05	8461.
1.01	18.30	37	.01	.00	.01	44.	1.02	19.30	87	.08	.04	.05	7850.
1.01	19.00	38	.01	.00	.01	53.	1.02	20.00	88	.08	.04	.05	7015.
1.01	19.30	39	.01	.00	.01	57.	1.02	20.30	89	.08	.04	.05	6112.
1.01	20.00	40	.01	.00	.01	55.	1.02	21.00	90	.08	.04	.05	5209.
1.01	20.30	41	.01	.00	.01	50.	1.02	21.30	91	.08	.04	.05	4376.
1.01	21.00	42	.01	.00	.01	43.	1.02	22.00	92	.08	.04	.05	3664.
1.01	21.30	43	.01	.00	.01	36.	1.02	22.30	93	.08	.04	.05	3073.
1.01	22.00	44	.01	.00	.01	30.	1.02	23.00	94	.08	.04	.05	2583.
1.01	22.30	45	.01	.00	.01	25.	1.02	23.30	95	.08	.04	.05	2176.
1.01	23.00	46	.01	.00	.01	21.	1.03	0.00	96	.08	.04	.05	1839.
1.01	23.30	47	.01	.00	.01	17.	1.03	.30	97	0.00	0.00	0.00	1558.
1.02	0.00	48	.01	.00	.01	15.	1.03	1.00	98	0.00	0.00	0.00	1321.
1.02	.30	49	.06	.01	.05	12.	1.03	1.30	99	0.00	0.00	0.00	1118.
1.02	1.00	50	.06	.01	.05	11.	1.03	2.00	100	0.00	0.00	0.00	943.
									SUM	23.91	20.27	3.64	111765.
										(607.)	(515.)	(93.)	(3164.83)

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	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	8601.	6533.	2305.	1113.	111292.
CMS	244.	185.	65.	32.	3151.
INCHES		13.66	19.28	19.39	19.39
MM		346.90	489.60	492.43	492.43
AC-FT		3240.	4572.	4599.	4599.
THOUS CU M		3996.	5640.	5673.	5673.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 1

4.	4.	4.	4.	4.	4.	3.	3.	3.	3.
3.	3.	3.	3.	3.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	3.	5.	11.	21.	32.	44.	53.	57.	55.
50.	43.	36.	30.	25.	21.	17.	15.	12.	11.
12.	13.	16.	19.	23.	25.	28.	30.	31.	33.
38.	53.	83.	127.	183.	244.	304.	355.	398.	434.
463.	488.	540.	674.	926.	1316.	1836.	2461.	3145.	4001.
5095.	6272.	7373.	8203.	8601.	8461.	7850.	7015.	6112.	5209.
4376.	3664.	3073.	2583.	2176.	1839.	1558.	1321.	1118.	943.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	8601.	6533.	2305.	1113.	111292.
CMS	244.	185.	65.	32.	3151.
INCHES		13.66	19.28	19.39	19.39
MM		346.90	489.60	492.43	492.43
AC-FT		3240.	4572.	4599.	4599.
THOUS CU M		3996.	5640.	5673.	5673.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 2

3.	3.	3.	3.	3.	3.	3.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	1.	1.	1.	1.	1.	1.	2.	2.
2.	2.	4.	8.	15.	24.	33.	40.	43.	41.
37.	32.	27.	22.	19.	16.	13.	11.	9.	9.
9.	10.	12.	14.	17.	19.	21.	22.	24.	25.
28.	40.	62.	95.	137.	183.	228.	267.	299.	325.
348.	366.	405.	505.	694.	987.	1377.	1845.	2358.	3001.
3821.	4704.	5530.	6152.	6451.	6346.	5888.	5261.	4584.	3906.
3282.	2748.	2305.	1937.	1632.	1379.	1168.	990.	838.	707.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	6451.	4900.	1729.	835.	83469.
CMS	183.	139.	49.	24.	2364.
INCHES		10.24	14.46	14.54	14.54
MM		260.17	367.20	369.32	369.32
AC-FT		2430.	3429.	3449.	3449.
THOUS CU M		2997.	4230.	4254.	4254.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 3

2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	3.	6.	10.	16.	22.	27.	28.	28.
25.	21.	18.	15.	12.	10.	9.	7.	6.	6.

6.	7.	8.	10.	11.	13.	14.	15.	16.	16.
19.	27.	41.	63.	91.	122.	152.	178.	199.	217.
232.	244.	270.	337.	463.	658.	918.	1230.	1572.	2001.
2548.	3136.	3687.	4102.	4301.	4231.	3925.	3508.	3056.	2604.
2188.	1832.	1537.	1291.	1088.	919.	779.	660.	559.	471.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4301.	3267.	1153.	556.	55646.
CMS	122.	93.	33.	16.	1576.
INCHES		6.83	9.64	9.69	9.69
MM		173.45	244.80	246.22	246.22
AC-FT		1620.	2286.	2299.	2299.
THOUS CU M		1998.	2820.	2836.	2836.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 4

1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	0.	0.	0.	0.	0.	0.	1.	1.
1.	1.	1.	3.	5.	8.	11.	13.	14.	14.
12.	11.	9.	7.	6.	5.	4.	4.	3.	3.
3.	3.	4.	5.	6.	6.	7.	7.	8.	8.
9.	13.	21.	32.	46.	61.	76.	89.	100.	108.
116.	122.	135.	168.	231.	329.	459.	615.	786.	1000.
1274.	1568.	1843.	2051.	2150.	2115.	1963.	1754.	1528.	1302.
1094.	916.	768.	646.	544.	460.	389.	330.	279.	236.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2150.	1633.	576.	278.	27823.
CMS	61.	46.	16.	8.	788.
INCHES		3.41	4.82	4.85	4.85
MM		86.72	122.40	123.11	123.11
AC-FT		810.	1143.	1150.	1150.
THOUS CU M		999.	1410.	1418.	1418.

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HYDROGRAPH ROUTING

2 ROUTE HYDROGRAPH THROUGH RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

GLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	240.	-1

STAGE	520.00	520.50	521.50	523.50	525.25	530.00
FLOW	0.00	52.50	421.30	1744.00	3323.60	9044.00
CAPACITY=	240.	254.	287.	302.	331.	390.

ELEVATION= 520. 521. 523. 524. 526. 530.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
520.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
525.3	2.8	1.5	176.

STATION 2, PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

1.	2.	3.	3.	3.	3.	3.	3.	3.	3.
3.	3.	3.	3.	3.	3.	3.	3.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	3.	4.	7.	13.	20.	27.	35.	41.
44.	44.	43.	40.	37.	33.	29.	26.	22.	20.
17.	16.	16.	16.	17.	19.	21.	23.	25.	27.
29.	34.	43.	72.	131.	190.	248.	299.	347.	390.
429.	471.	510.	597.	778.	1085.	1514.	2081.	2937.	3790.
4919.	6047.	7215.	8089.	8570.	8511.	7967.	7154.	6264.	5367.
4529.	3761.	3213.	2739.	2297.	1996.	1715.	1492.	1256.	1054.

STORAGE

240.	240.	240.	240.	240.	240.	240.	240.	240.	240.
240.	240.	240.	240.	240.	240.	240.	240.	240.	240.
240.	240.	240.	240.	240.	240.	240.	240.	240.	240.
240.	240.	240.	241.	241.	242.	243.	244.	245.	245.
246.	246.	246.	245.	245.	244.	244.	243.	243.	243.
242.	242.	242.	242.	242.	243.	243.	243.	243.	244.
244.	244.	246.	248.	250.	252.	254.	257.	259.	261.
262.	263.	264.	267.	271.	279.	290.	305.	317.	326.
334.	342.	350.	356.	359.	358.	355.	350.	344.	337.
331.	326.	321.	315.	309.	303.	297.	290.	283.	278.

STAGE

520.0	520.0	520.0	520.0	520.0	520.0	520.0	520.0	520.0	520.0
520.0	520.0	520.0	520.0	520.0	520.0	520.0	520.0	520.0	520.0
520.0	520.0	520.0	520.0	520.0	520.0	520.0	520.0	520.0	520.0
520.0	520.0	520.0	520.0	520.1	520.1	520.2	520.3	520.3	520.4
520.4	520.4	520.4	520.4	520.4	520.3	520.3	520.2	520.2	520.2.
520.2	520.2	520.2	520.2	520.2	520.2	520.2	520.2	520.2	520.3
520.3	520.3	520.4	520.6	520.7	520.9	521.0	521.2	521.3	521.4
521.5	521.6	521.6	521.8	522.0	522.5	523.2	523.9	524.8	525.6
526.2	526.8	527.3	527.7	527.9	527.8	527.6	527.3	526.9	526.4
526.0	525.5	525.1	524.6	524.1	523.8	523.5	523.1	522.8	522.5

PEAK OUTFLOW IS 8570. AT TIME 42.50 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	8570.	6534.	2287.	1104.	110367.
CMS	243.	185.	65.	31.	3125.
INCHES		13.66	19.12	19.23	19.23
MM		346.92	485.72	488.34	488.34
AC-FT		3240.	4536.	4561.	4561.
THOUS CU M		3996.	5595.	5625.	5625.

STATION 2, PLAN 1, RATIO 2

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

1.	1.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	1.	1.	1.	1.
2.	2.	2.	3.	5.	9.	15.	21.	26.	30.
33.	33.	32.	30.	28.	25.	22.	19.	17.	15.
13.	12.	12.	12.	13.	14.	16.	17.	19.	20.
22.	25.	32.	45.	83.	138.	186.	230.	264.	294.
320.	343.	369.	423.	581.	813.	1144.	1548.	2044.	2784.
3594.	4596.	5355.	6075.	6414.	6391.	5982.	5379.	4713.	4012.
3398.	2917.	2436.	2080.	1796.	1553.	1318.	1104.	934.	790.

STORAGE

240.	240.	240.	240.	240.	240.	240.	240.	240.	240.
240.	240.	240.	240.	240.	240.	240.	240.	240.	240.
240.	240.	240.	240.	240.	240.	240.	240.	240.	240.
240.	240.	240.	240.	241.	241.	242.	243.	243.	244.
244.	244.	244.	244.	244.	243.	243.	243.	242.	242.
242.	242.	242.	242.	242.	242.	242.	242.	242.	243.
243.	243.	244.	246.	248.	250.	252.	253.	255.	256.
258.	259.	260.	262.	266.	272.	281.	291.	304.	315.
324.	331.	337.	342.	345.	344.	342.	337.	332.	327.
323.	317.	311.	305.	299.	292.	285.	280.	275.	272.

STAGE

520.0	520.0	520.0	520.0	520.0	520.0	520.0	520.0	520.0	520.0
520.0	520.0	520.0	520.0	520.0	520.0	520.0	520.0	520.0	520.0
520.0	520.0	520.0	520.0	520.0	520.0	520.0	520.0	520.0	520.0
520.0	520.0	520.0	520.0	520.1	520.1	520.1	520.2	520.2	520.3
520.3	520.3	520.3	520.3	520.3	520.2	520.2	520.2	520.2	520.1
520.1	520.1	520.1	520.1	520.1	520.1	520.1	520.2	520.2	520.2
520.2	520.2	520.3	520.4	520.6	520.7	520.9	521.0	521.1	521.2
521.2	521.3	521.4	521.5	521.7	522.1	522.6	523.2	523.8	524.7
525.4	526.0	526.4	526.8	526.9	526.9	526.7	526.4	526.1	525.7
525.3	524.8	524.3	523.9	523.6	523.2	522.9	522.5	522.3	522.1

PEAK OUTFLOW IS 6414. AT TIME 42.50 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	6414.	4897.	1714.	827.	82705.
CMS	182.	139.	49.	23.	2342.
INCHES		10.24	14.33	14.41	14.41
MM		259.99	363.98	365.95	365.95
AC-FT		2428.	3399.	3418.	3418.
THOUS CU M		2995.	4193.	4216.	4216.

STATION 2, PLAN 1, RATIO 3

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

1.	1.	1.	1.	2.	2.	2.	2.	2.	2.
2.	2.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	2.	4.	6.	10.	14.	17.	20.
22.	22.	22.	20.	19.	17.	15.	13.	11.	10.
9.	8.	8.	8.	9.	10.	11.	12.	12.	13.
14.	17.	21.	30.	43.	73.	119.	152.	178.	199.
217.	232.	248.	283.	356.	510.	759.	1041.	1364.	1711.
2261.	2976.	3542.	4064.	4271.	4263.	3983.	3588.	3174.	2751.
2314.	1995.	1704.	1469.	1225.	1027.	868.	735.	623.	526.

STORAGE

240.	240.	240.	240.	240.	240.	240.	240.	240.	240.
240.	240.	240.	240.	240.	240.	240.	240.	240.	240.
240.	240.	240.	240.	240.	240.	240.	240.	240.	240.
240.	240.	240.	240.	240.	241.	241.	242.	242.	243.
243.	243.	243.	243.	242.	242.	242.	242.	241.	241.
241.	241.	241.	241.	241.	241.	241.	242.	242.	242.
242.	242.	243.	244.	246.	248.	249.	251.	252.	252.
253.	254.	254.	256.	259.	264.	271.	278.	286.	296.
306.	318.	324.	328.	329.	329.	327.	324.	320.	315.
309.	303.	296.	289.	283.	278.	274.	270.	267.	265.

STAGE

520.0	520.0	520.0	520.0	520.0	520.0	520.0	520.0	520.0	520.0
520.0	520.0	520.0	520.0	520.0	520.0	520.0	520.0	520.0	520.0
520.0	520.0	520.0	520.0	520.0	520.0	520.0	520.0	520.0	520.0
520.0	520.0	520.0	520.0	520.0	520.1	520.1	520.1	520.2	520.2
520.2	520.2	520.2	520.2	520.2	520.2	520.1	520.1	520.1	520.1
520.1	520.1	520.1	520.1	520.1	520.1	520.1	520.1	520.1	520.1
520.1	520.2	520.2	520.3	520.4	520.6	520.7	520.8	520.8	520.9
520.9	521.0	521.0	521.1	521.3	521.6	522.0	522.4	522.9	523.5
524.1	524.9	525.4	525.7	525.8	525.8	525.7	525.4	525.1	524.6
524.1	523.8	523.4	523.1	522.7	522.4	522.2	522.0	521.8	521.7

PEAK OUTFLOW IS 4271. AT TIME 42.50 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4271.	3253.	1141.	550.	55046.
CMS	121.	92.	32.	16.	1559.
INCHES		6.80	9.54	9.59	9.59
MM		172.74	242.24	243.56	243.56
AC-FT		1613.	2262.	2275.	2275.
THOUS CU M		1990.	2791.	2806.	2806.

STATION 2, PLAN 1, RATIO 4

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	0.	0.	0.	0.
1.	1.	1.	1.	2.	3.	5.	7.	9.	10.
11.	11.	11.	10.	9.	8.	7.	7.	6.	5.
4.	4.	4.	4.	4.	5.	5.	6.	6.	7.

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7.	8.	11.	15.	21.	30.	40.	52.	81.	98.
108.	115.	125.	144.	184.	251.	340.	481.	678.	871.
1109.	1388.	1648.	1918.	2094.	2131.	2042.	1865.	1664.	1463.
1231.	1029.	862.	723.	608.	513.	434.	384.	335.	287.

STORAGE

240.	240.	240.	240.	240.	240.	240.	240.	240.	240.
240.	240.	240.	240.	240.	240.	240.	240.	240.	240.
240.	240.	240.	240.	240.	240.	240.	240.	240.	240.
240.	240.	240.	240.	240.	240.	241.	241.	241.	241.
241.	241.	241.	241.	241.	241.	241.	241.	241.	241.
241.	241.	241.	241.	241.	241.	241.	241.	241.	241.
241.	241.	241.	242.	243.	244.	245.	247.	248.	249.
249.	249.	250.	250.	252.	254.	258.	264.	269.	274.
280.	287.	295.	301.	305.	306.	304.	300.	295.	289.
283.	278.	273.	270.	267.	264.	262.	260.	258.	256.

STAGE

520.0	520.0	520.0	520.0	520.0	520.0	520.0	520.0	520.0	520.0
520.0	520.0	520.0	520.0	520.0	520.0	520.0	520.0	520.0	520.0
520.0	520.0	520.0	520.0	520.0	520.0	520.0	520.0	520.0	520.0
520.0	520.0	520.0	520.0	520.0	520.0	520.0	520.1	520.1	520.1
520.1	520.1	520.1	520.1	520.1	520.1	520.1	520.1	520.1	520.0
520.0	520.0	520.0	520.0	520.0	520.0	520.1	520.1	520.1	520.1
520.1	520.1	520.1	520.1	520.2	520.3	520.4	520.5	520.6	520.6
520.7	520.7	520.7	520.7	520.9	521.0	521.3	521.6	521.9	522.2
522.5	523.0	523.4	523.7	523.9	523.9	523.8	523.6	523.4	523.1
522.7	522.4	522.2	522.0	521.8	521.6	521.5	521.4	521.3	521.1

PEAK OUTFLOW IS 2131. AT TIME 43.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2131.	1625.	568.	274.	27435.
CMS	60.	46.	16.	8.	777.
INCHES		3.40	4.75	4.78	4.78
MM		86.29	120.73	121.39	121.39
AC-FT		806.	1128.	1134.	1134.
THOUS CU M		994.	1391.	1398.	1398.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

3 CHANNEL ROUTE AT SECTION 800 FT BELOW DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
7	1	0	0	0	0	0	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS*	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0350	.0350	.0350	476.0	500.0	800.	.01400

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 500.00 30.00 490.00 90.00 480.00 92.00 476.00 98.00 477.00
100.00 480.00 170.00 490.00 200.00 500.00

STORAGE	0.00	.09	.27	.48	.84	1.58	2.70	4.20	6.09	8.35
	10.99	14.02	17.34	20.84	24.51	28.36	32.38	36.58	40.96	45.51
OUTFLOW	0.00	18.71	89.52	200.00	401.67	798.82	1489.74	2557.65	4076.39	6113.71
	8732.96	11994.08	16305.59	21301.55	26949.21	33254.50	40225.92	47873.72	56209.39	65245.30
STAGE	476.00	477.26	478.53	479.79	481.05	482.32	483.58	484.84	486.11	487.37
	488.63	489.89	491.16	492.42	493.68	494.95	496.21	497.47	498.74	500.00
FLOW	0.00	18.71	89.52	200.00	401.67	798.82	1489.74	2557.65	4076.39	6113.71
	8732.96	11994.08	16305.59	21301.55	26949.21	33254.50	40225.92	47873.72	56209.39	65245.30

STATION 3, PLAN 1, RTIO 1

OUTFLOW

2.	1.	3.	3.	3.	3.	3.	3.	3.	3.
3.	3.	3.	3.	3.	3.	3.	3.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	3.	4.	7.	12.	19.	27.	34.	41.
44.	45.	43.	41.	37.	33.	30.	26.	23.	20.
18.	16.	16.	16.	17.	19.	21.	23.	25.	27.
29.	33.	42.	69.	128.	188.	245.	297.	345.	389.
426.	469.	508.	591.	768.	1071.	1495.	2062.	2902.	3773.
4875.	6029.	7176.	8083.	8553.	8529.	7976.	7184.	6279.	5399.
4543.	3789.	3219.	2761.	2304.	2009.	1722.	1500.	1266.	1060.

STOR

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	1.	1.	1.	1.
1.	1.	1.	1.	2.	2.	3.	4.	5.	6.
7.	8.	9.	10.	11.	11.	10.	9.	9.	8.
7.	6.	5.	4.	4.	3.	3.	3.	2.	2.

STAGE

476.1	476.1	476.2	476.2	476.2	476.2	476.2	476.2	476.2	476.2
476.2	476.2	476.2	476.2	476.2	476.2	476.2	476.2	476.2	476.2
476.2	476.2	476.1	476.1	476.1	476.1	476.1	476.1	476.1	476.1
476.1	476.1	476.2	476.3	476.5	476.8	477.3	477.4	477.5	477.7
477.7	477.7	477.7	477.7	477.6	477.5	477.5	477.4	477.3	477.3
477.2	477.1	477.1	477.1	477.2	477.3	477.3	477.3	477.4	477.4
477.4	477.5	477.7	478.2	479.0	479.6	480.1	480.4	480.7	481.0

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MAXIMUM STORAGE = 6.

MAXIMUM STAGE IS 486.2

STATION 3, PLAN 1, RTIO 4

OUTFLOW

0.	0.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	0.	0.	0.	0.
1.	1.	1.	1.	2.	3.	5.	7.	8.	10.
11.	11.	11.	10.	9.	8.	8.	7.	6.	5.
4.	4.	4.	4.	4.	5.	5.	6.	6.	7.
7.	8.	10.	14.	21.	30.	40.	51.	79.	98.
107.	116.	124.	143.	181.	249.	335.	473.	668.	864.
1098.	1378.	1639.	1908.	2091.	2131.	2048.	1871.	1672.	1469.
1242.	1034.	869.	727.	614.	516.	438.	385.	338.	288.

STOR

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	1.	1.	1.	1.	2.
2.	3.	3.	3.	4.	4.	3.	3.	3.	3.
2.	2.	2.	1.	1.	1.	1.	1.	1.	1.

STAGE

476.0	476.0	476.0	476.0	476.1	476.1	476.1	476.1	476.1	476.1
476.1	476.1	476.1	476.0	476.0	476.0	476.0	476.0	476.0	476.0
476.0	476.0	476.0	476.0	476.0	476.0	476.0	476.0	476.0	476.0
476.0	476.0	476.0	476.1	476.1	476.2	476.3	476.4	476.6	476.7
476.7	476.7	476.7	476.7	476.6	476.6	476.5	476.4	476.4	476.3
476.3	476.3	476.3	476.3	476.3	476.3	476.4	476.4	476.4	476.5
476.5	476.6	476.7	477.0	477.3	477.5	477.6	477.8	478.3	478.6
478.7	478.8	478.9	479.1	479.6	480.1	480.6	481.3	481.9	482.4
482.9	483.4	483.8	484.1	484.3	484.3	484.2	484.0	483.8	483.5
483.1	482.7	482.4	482.1	481.7	481.4	481.2	480.9	480.7	480.3

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2131.	1625.	568.	274.	27419.
CMS	60.	46.	16.	8.	776.
INCHES		3.40	4.75	4.78	4.78
MM		86.26	120.67	121.32	121.32
AC-FT		806.	1127.	1133.	1133.
THOUS CU M		994.	1390.	1398.	1398.

MAXIMUM STORAGE = 4.

MAXIMUM STAGE IS 484.3

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PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 1.00	RATIO 2 .75	RATIO 3 .50	RATIO 4 .25
HYDROGRAPH AT	1	4.45	1	8601.	6451.	4301.	2150.
	(	11.53)	(	243.56)(	182.67)(	121.78)(	60.89)(
ROUTED TO	2	4.45	1	8570.	6414.	4271.	2131.
	(	11.53)	(	242.66)(	181.62)(	120.95)(	60.35)(
ROUTED TO	3	4.45	1	8553.	6427.	4276.	2131.
	(	11.53)	(	242.18)(	181.98)(	121.07)(	60.35)(

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SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	520.00	520.00	525.25
STORAGE	240.	240.	322.
OUTFLOW	0.	0.	3324.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	527.67	2.62	359.	8570.	6.50	42.50	0.00
.75	526.93	1.68	345.	6414.	5.50	42.50	0.00
.50	525.85	.60	329.	4271.	3.00	42.50	0.00
.25	523.93	0.00	306.	2131.	0.00	43.00	0.00

PLAN 1 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	8553.	488.5	42.50
.75	6427.	487.5	42.50
.50	4276.	486.2	42.50
.25	2131.	484.3	43.00

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STABILITY ANALYSIS

APPENDIX E

TAMS

Job No. 1579-20 Sheet 1 of 12
Project NYS Dam Inspection Date 7-27-81
Subject Greenhaven Correctional Facility By JW
Ch'k. by

Assumptions:

1) Unit Weight of Concrete is 150pcf

2) Ice loads of 5000 lbs/ft² acts at spillway crest (COE Criteria)

3) Friction Angle of foundation Rock assumed $\phi = 40°$
Cohesion or adhesion assumed $c = 500$psf
properties same at abutments

4) Dam Site is in Zone 1 - However Based on seismic activity will be considered as Resting in Zone 2 area

5) No back fill and minimum silt/sedimentation on upstream side of Dam

6) Normal operating level of Lake is at El. 520.0

7) Assume Crack at Pt A (see 3 of 4) in case of overturning

Additional Data: Based on Backwater Flood Routing Study

Case	Headwater El.	Tailwater El.
½ PMF	525.85	503.2
1 PMF	527.87	508.5

Cases Evaluated

Case I Normal Loading; Lake Level at minimum crest El. of spillway El. 520.0
No Ice Load

Case II Case I condition with the addition of assumed ice loading - 1ft Equivalent

Case III Unusual Loading; Lake Level at ½ PMF Stage

Case IV Extreme Loading; Lake Level at PMF Stage

TAMS

Job No. 1579-20 Sheet 2 of 12
Project NYS Dam Inspection Date 7-27-87
Subject Greenwaven Conection Facility Dam By JW
Ch'k. by

STACility Criteria

a) Overturning - Resultant Force shall be contained within middle 1/3 of the base for Cases I thru III and within the base

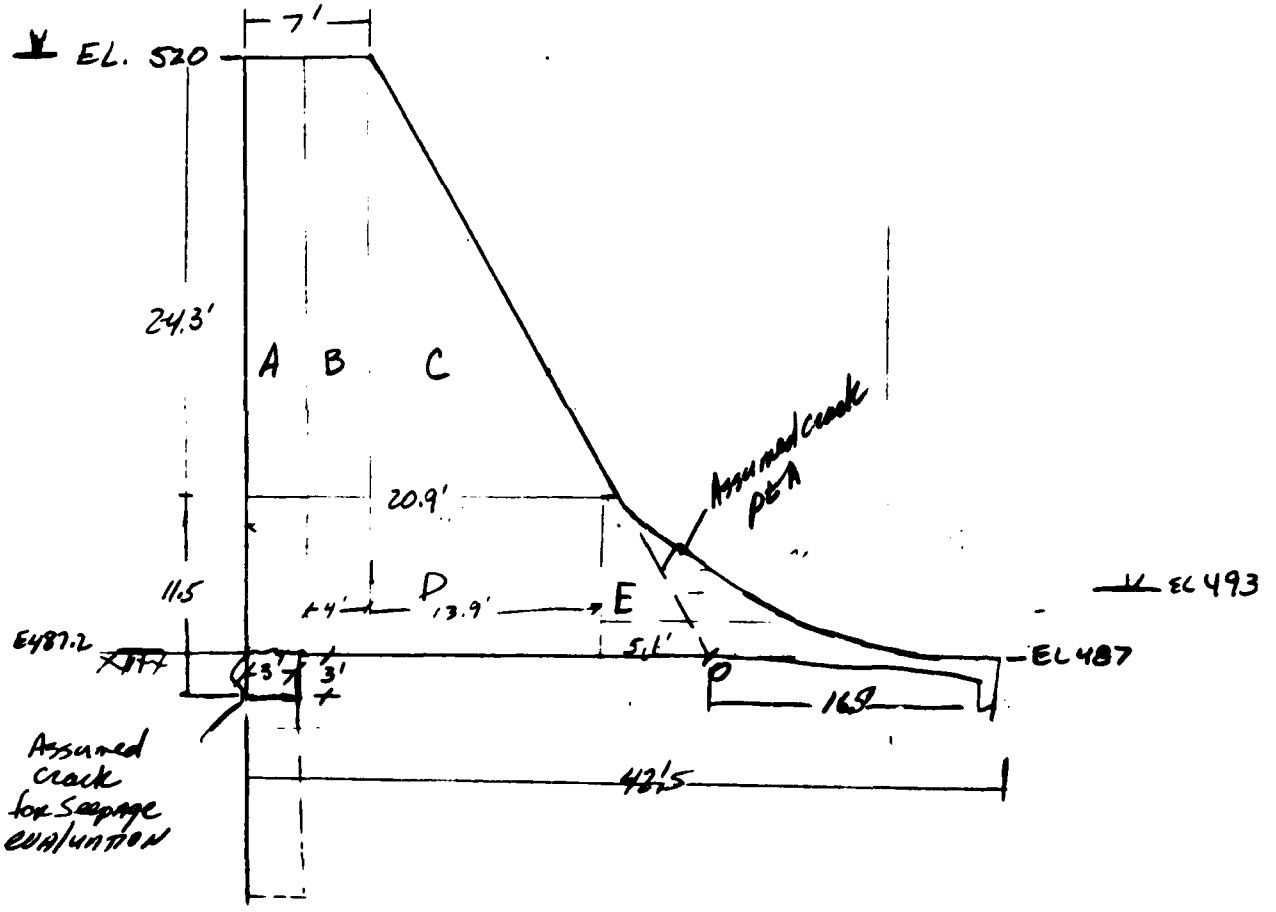
b) Sliding - Factor of safety against sliding failure shall be 3.0 or greater for Case I thru III and greater than 1.5 for Case IV

Sign convention
+ - Resisting moment
- - driving moment

TAMS

Job No. 1579-20 Sheet 8 of 12
Project NYS Dam Inspection Date 7-27-81
Subject GHCFD By JW
Ch'k. by

Design Section from station 0+74 to 1+24
(Simplified Section)



Calculate Mass of Section

A - $3 \times 35.8 \times .150 = 16.11$ kips $MA_o = 24.5'$

B - $4 \times 32.8 \times .150 = 19.68$ kips $MA_o = 21.0'$

C - $\frac{1}{2} \times 24.3 \times 13.9 \times .150 = 25.3$ kips $MA_o = 14.4'$

D - $8.5 \times 13.9 \times .150 = 17.72$ kips $MA_o = 12.0'$

E - $\frac{1}{2} \times 5.1 \times 8.5 \times .150 = 3.25$ kips $MA_o = 3.4$

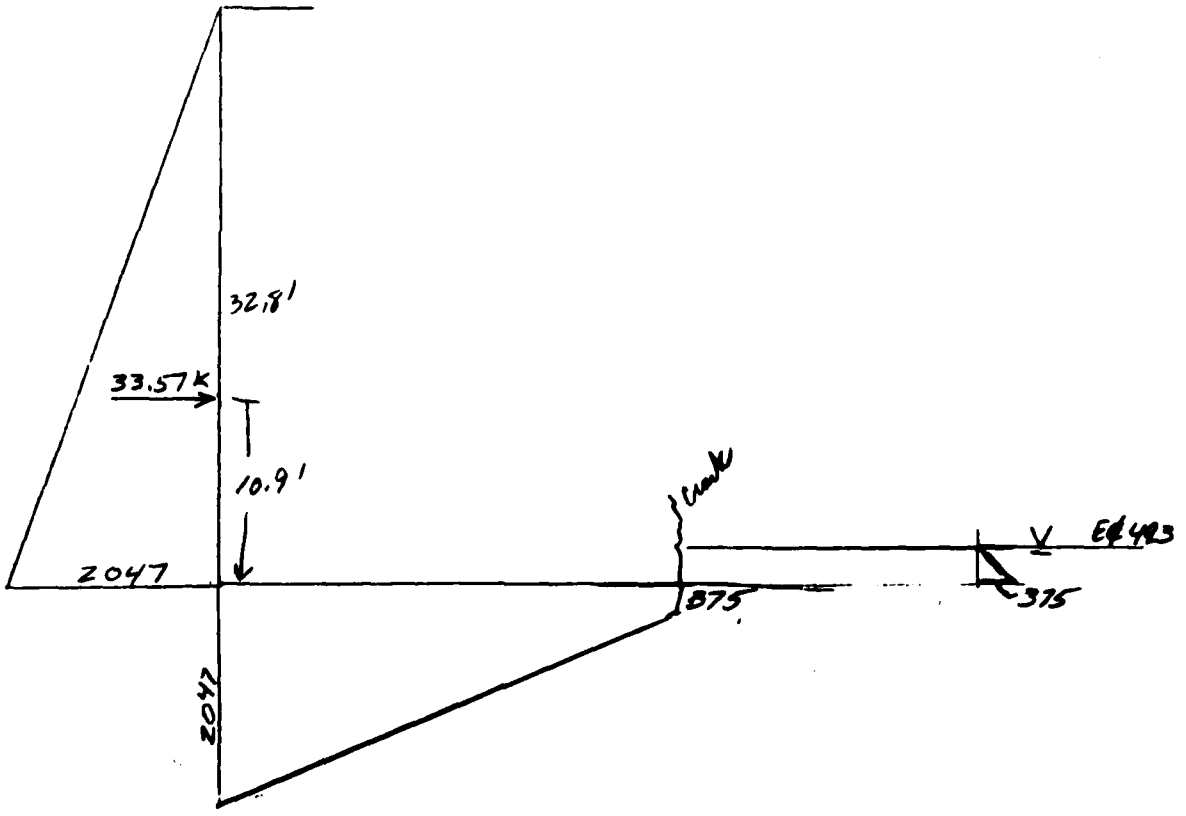
TAMS

Job No. 15720 Sheet 4 of 12
Project NYS Dam Inspection Date 7-27-87
Subject GCFD By JW
Ch'k. by

$\Sigma F_v = 82.04$ Kips

$\Sigma M_0 = +1396$ K ft

Hydrostatic forces Normal Pool



TAMS

Job No. 1579-20 Sheet 5 of 12
Project NYS Dam Inspection Date 7-27-81
Subject GCFD By JWJ
Ch'k. by

$F_{H_1} = 62.4 \times 32.8 \times .5 = -33,571 \text{ kips}$ $M_A = \frac{32.8}{3} = 10.9'$

$F_{up} = \frac{2047+385}{2} \times 260 = 31.5 \text{ kips}$ $M_{A_0} = 17.1'$.

$M_{A_0} = \frac{31500}{2} - 375x + \frac{1}{2}(64.3)x^2$

$x^2 + 11.66x - 490 = 0$

$x = 17.1$

$F_{H_2} = \frac{1}{2}(375)6 = 1.125 \text{ kips}$ $M_A = = 2.0'$

$\Sigma F_H = -32.44 \text{ k}$ $\Sigma M_0 = -870.8 \text{ kip ft}$

$\Sigma F_V = -31.5 \text{ kips}$

Shear Resistance at Cut off / Key

$0.02 \times 3000 \text{ psi} = 60 \text{ psi}$

$\text{Area} = 36 \times 12 = 432 \text{ in}^2$

$\text{Shear} = 432 \times .06 = 25.92 \text{ kips/ft}$

TAMS

Job No. 1579-20 Sheet 6 of 12
Project NYS Dam Inspection Date 7-27-81
Subject GCFD By JWL
Ch'k. by

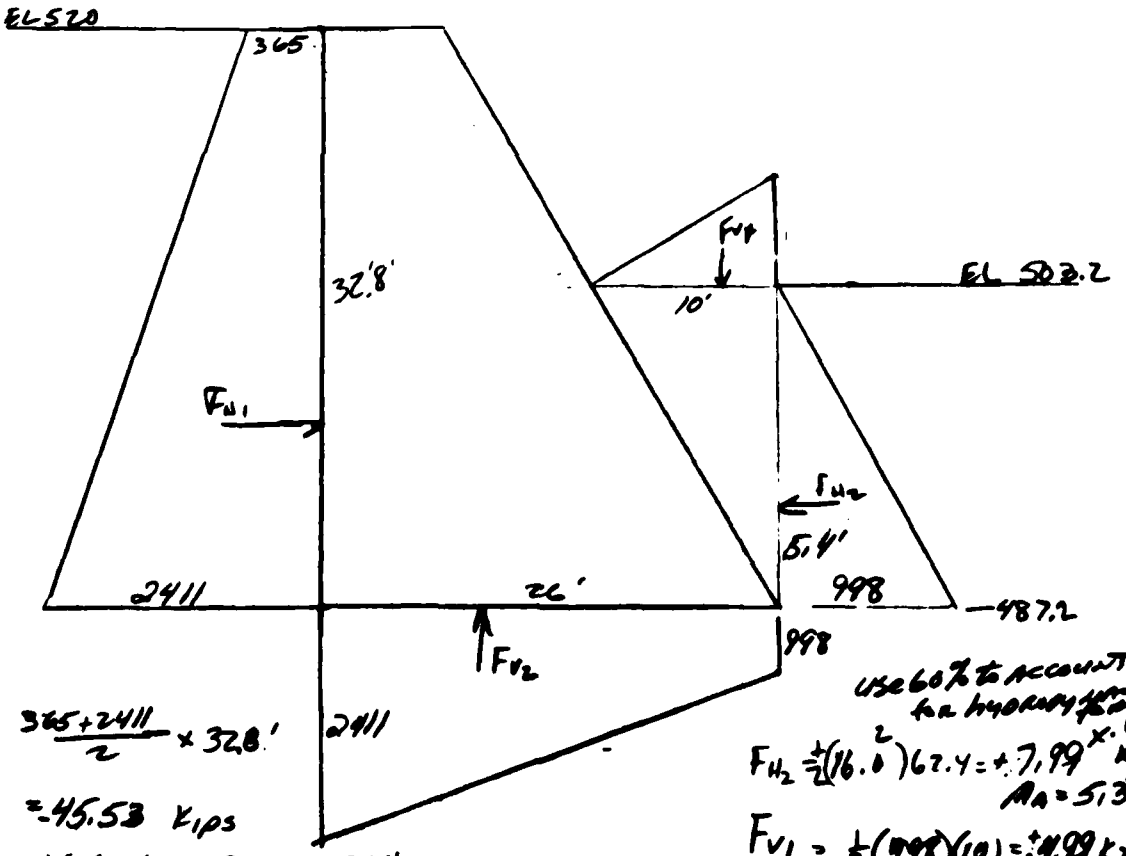
Case II ICE forces

$F_H = -5{,}000$ lbs.

$M_{A_0} = 519.5 - 487.2 = 32.3$

$M = 5.0 \times 32.3 = -161.5$ k-ft

Case III Hydrostatic forces ½ PMF Case
525.85



$F_{H_1} = \frac{365+2411}{2} \times 32.8' = -45.53$ kips

$\bar{X} = M_A = \frac{1}{3}\left(\frac{2a+b}{a+b}\right) = \frac{32.8}{3}\left(\frac{2\times365+2411}{365+2411}\right)$

$M_A = 12.7'$

Use 60% to account for hydrodynamic

$F_{H_2} = \frac{1}{2}(16.0^2)62.4 = +7.99^{x.6}$ k

$M_A = 5.3$

$F_{V_1} = \frac{1}{2}(.998)(10) = +4.99$ k x.6

$M_A = 3.3$

$F_{V_2} = \frac{2411+998}{2} \times 26 = 44.32$ kips

$\bar{X} = \frac{26}{3}\left(\frac{998+2411}{998+2411}\right) = 11.2$

$M_A = 26 - 11.2 = 14.8$

TAMS

Job No. 1579-20 Sheet 7 of 12
Project NYS Dam Inspection Date 7-27-81
Subject GCFD By JW
Ch'k. by

Case III Summary

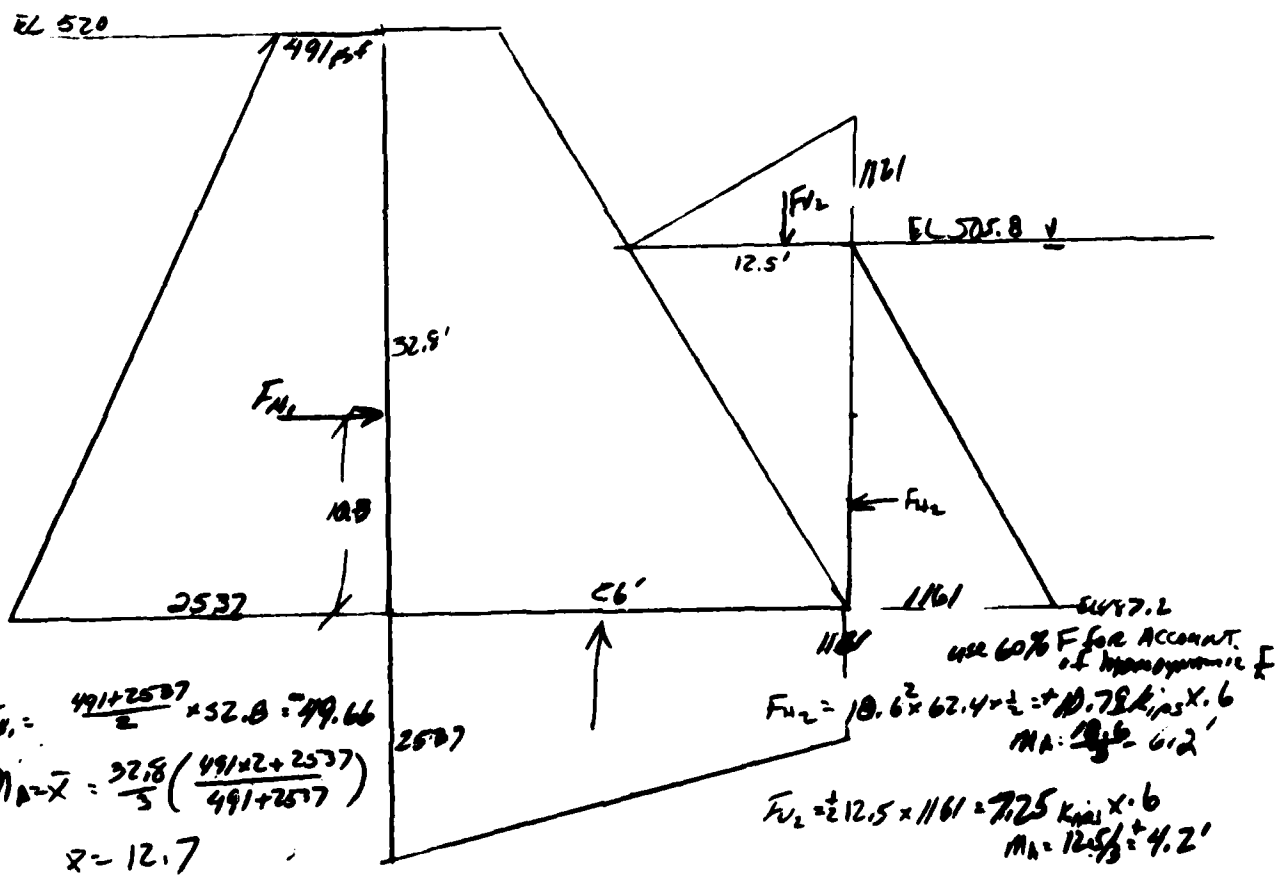
$\Sigma F_H = -40.73$ Kips

$\Sigma F_V = -91.32$ Kips

$\Sigma M_O = -1199.$ K-ft

Case III Hydrostatic Forces Full PMF

527.82



$F_{H_1} = \frac{491+2537}{2} \times 32.8 = 49.66$

$M_{A-\bar{X}} = \frac{32.8}{3}\left(\frac{491+2+2537}{491+2537}\right)$

$\bar{X} = 12.7$

$F_{H_2} = 10.6^2 \times 62.4 \times \frac{1}{2} = 10.78$ k/ft $\times .6$

$M_A = \frac{10.6}{3} = 6.2'$

use 60% F for Accumulation of Hydrodynamic F

$F_{V_2} = \frac{1}{2} 12.5 \times 1161 = 7.25$ Kips $\times .6$

$M_A = \frac{12.5}{3} = 4.2'$

$F_{V_1} = \frac{2537+1161}{2} \times 26 = 48.07$ Kips

$\bar{X} = 11.4$ $M_A = 26 - 11.4 = 14.61$

TAMS

Job No. 1579-20 Sheet 8 of 12
Project NYS Dam Inspection Date 7-27-81
Subject GCFD By JW
Ch'k. by

Case III

$\Sigma F_H = -43.18$ kips

$\Sigma F_V = -43.72$ kips

$\Sigma M_0 = -1274.5$ k-ft

Case I

FIND centroid of Mass for Dam Section on Pg. 3

Total Mass 82.63 kips $\bar{x}_0 = \frac{1437.3}{82.63} = 17.4'$

find $\bar{y}$ relative to top of Dam

Resultant Mass $\frac{82.63}{2} = 41.32$ kips

$$\frac{82,630}{2} = \bar{y}(3\times150) + \bar{y}\times4\times150 + \tfrac{1}{2}(.572)\bar{y}^2(150)$$

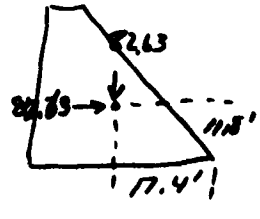
$$41,315 = 450\bar{y} + 600\bar{y} + 42.9\bar{y}^2$$

$$\bar{y}^2 + 24.7\bar{y} - 963 = 0$$

try $\bar{y} = 14$ -42.2

$y = 17$ $-25.4.1$
$y = 20$ -6.9
$y = 21$ -3.3
$y = 21.3$ 16.8
21.1 3.38
use $\bar{y} = 21.0$ ok

$M_{A_0} = 11.9$



TAMS

Job No. 1579.20 Sheet 9 of 12
Project NYS Dam Inspection Date 7-22-87
Subject GCFD By
Ch'k. by

For Zone 2 Earthquake Loading use horizontal load factors based on 0.05g

1) Dynamic Load

Inertial forces = 82.63 kips × 0.05 = 4.13 kips
@ centroid M_A = 11.8'

M_D = -48.75 k-ft

No backfill ∴ no soil force component

2) Hydrodynamic Load

Zangars Method 32.8' free water
$\theta = 0$ $C = 0.73$

$P_o = 0.73 \times .05 \times 0.0624 \times 32.8 = 0.075$ kips

$P_T = \frac{1}{2}(.075)(32.8) = 1.225$ kips

$M_A = 32.8 \times .4 = 13.12$

$M_o = 13.12 \times 1.225 = 16.1$ k-ft

TAMS

Job No. 1579-20 Sheet 10 of 12
Project NYS Dam Inspection Date 7-27-81
Subject GCFD By JW
Ch'k. by

Analysis

CASE I - NORMAL LOADING

	F_v	F_H	ΣM_o
DEAD LOAD	82.1 k	—	+1396 kft
Key Shear Resistance	—	+25.92	
Hydrostatic Forces	-31.5	-32.44	-870.8
	50.6	-6.52	525.2

$$\bar{e} = \frac{26}{2} - \frac{525.2}{50.6} = 2.62$$

IS $\frac{26}{6} - |2.62| \geq 0$ yes (4.71') OK RESULTANT WITHIN MIDDLE ⅓

F.S. AGAINST SLIDING

$$F.S. \frac{50.6 \tan 40 + 0.5(26.0)}{6.52} = 8.59 > 3$$ OK

CASE II - ICE LOADING	F_v(k/ft)	F_H(k/ft)	ΣM_o(k-ft)
Dead Load	82.1	—	+1396
Key Shear Resistance	—	+25.92	—
Hydrostatic Forces	31.5	-32.44	-870
Ice Force	—	-5.0	-161.5
	50.6	-11.52	364.5

$$\bar{e} = \frac{26}{2} - \frac{364.5}{50.6} = 5.79$$

IS $\frac{26}{6} - |5.79| \geq 0$ (-1.46') NO RESULTANT LOCATED OUTSIDE MIDDLE ⅓

F.S. AGAINST SLIDING $\frac{50.6 \tan 40 + .5(26.0)}{11.52} = 4.81 > 3$ OK

CHECK FOUNDATION PRESSURE $p = \frac{50.6}{26}\left(1 \pm \frac{6 \times 5.79}{26}\right)\frac{1000}{144} = 13.5 \pm 18.05 = 31.55$ & -4.54 psi
OK

TAMS

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Case III ½ PMF

	F_V (k/ft)	F_H (k/ft)	ΣM_o (k-ft)
Dead Load	82.1	—	+1396
Key shear Resistance		25.92	
Hydrostatic Load	-31.32	-40.73	-1199
	50.77	-14.81	197

$$\bar{x} = \frac{26}{2} - \frac{197}{50.77} = 8.16$$

is $26/6 - 8.16 \geq 0$ (-3.83) NO

Resultant is outside middle ⅓

Check foundation Pressure $P = \frac{50.77}{26}\left(1 \pm \frac{6 \times 8.16}{26}\right)\frac{1000}{144} = 10.89 \pm 20.50$ psi

$= 31.39$ & -9.61 psi

OK

F.S. Against Sliding $\frac{50.77 \tan 40 + .5(26)}{14.81} = 3.18 > 3$ OK

Case IV Full PMP

	F_V (k/ft)	F_H (k/ft)	ΣM_o (k-ft)
Dead Load	82.1	—	+1396
Key Shear Resistance		25.92	
Hydrostatic Load	-43.72	-43.18	-1274.5
	38.4	-17.26	121.5

$$\bar{x} = \frac{26}{2} - \frac{121.5}{38.4} = 9.83$$

is $\frac{26}{6} - |9.83| \geq 0$ (-5.50) NO

Resultant lies outside middle ⅓

Check foundation Pressure

$$P = \frac{38.4}{26}\left(1 \pm \frac{6 \times 9.83}{26}\right)\frac{1000}{144} = 11.26 \pm 23.26 \text{ psi} \quad \begin{matrix} 33.52 \text{ psi} \\ -13.0 \text{ psi} \end{matrix}$$

F.S. Against Sliding

$$F.S. = \frac{38.4 \tan 40 + .500(26)}{17.26} = 3.02 > 3 \quad \text{Acceptable}$$

TAMS

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Case V - Dynamic Loading

	F_x (kips)	F_y (kips)	$\sum M_o$ (k-ft)
End Shear	—		
Dead Load	82.1	—	+1396
Key Shear Resistance	—	25.92	—
Hydrostatic load	-31.5	-32.44	-870.8
hydrodynamic load	—	-4.13	-48.75
Inertia load	—	-1.225	-16.1
	50.6	-11.87	460.35

$$\bar{e} = \frac{26}{2} - \frac{460.35}{50.6} = 3.90$$

Is $\frac{26}{4} - |3.90| \geq 0$ (2.59) yes
resultant is within base

F.S. Against Sliding

$$\frac{50.6 \tan 40° + 0.5(26)}{11.87} = 4.67 \geq 1.5 \text{ OK}$$

Summary

Case	Location of Resultant	F.S. Against Sliding	Max Foundation Pressure
I	within middle 1/3	8.50	—
II	1.46' outside middle 1/3	4.81	31.55 psi OK
III	3.83' outside middle 1/3	3.18	31.39 psi OK
IV	5.50' outside middle 1/3	3.02	32.52 psi OK
V	within Base	4.67	—

Criteria of Acceptance - Cases I, II, III-IV, Resultant within middle 1/3
F.S. $\geq$ 3.0 ; for Case V Resultant must be within
Base F.S. $\geq$ 1.5

REFERENCES

APPENDIX F

REFERENCES

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3. "Recommended Guidelines for Safety Inspection of Dams", Department of the Army, Office of the Chief of Engineers, Appendix B.

4. The University of the State of New York, The State Education Department State Museum and Science Service Geological Survey - MAP and Chart Serves No. 5, Geologic MAP of New York 1961, Lower Hudson Sheet.


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